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Switzerland's "Hunter 80" programme

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Editor's Letter

70 YEARS AGO, on July 20, 1951, Sqn Ldr Neville Duke lifted the shapely prototype Hawker P.1067 from the runway at Boscombe Down for its maiden flight, prefacing the long, illustrious history of the Hunter, described by its designer Sydney Camm as "my most beautiful aeroplane". Not only did the type become one of Britain's most enduringly popular post-war military aircraft (with pilots and public alike), it was also a commercial success, being exported to 22 nations over a career spanning more than six decades.

Nearly 30 years after that first flight, Switzerland, which had acquired its first Hunter Mk 58 interceptors in 1958, saw life in the old dog yet, and resolved to teach it new tricks as a ground-attacker. Thus was the elegant fighter reconfigured to carry contemporary cutting-edge air-to-ground weaponry as part of the Flugwaffe's "Hunter 80" programme. Using declassified Swiss tactical documents and his own stunning air-to-air photography, Peter Lewis opens a two-part series on the programme in celebration of the 70th birthday of this most adaptable — and exquisitely graceful — Cold War icon.

We were much saddened to hear of the death of our old friend, author, pilot and renowned airshow commentator Melvyn Hiscock after a long battle with cancer, on February 20. As anyone who met him will know, his enthusiasm was infectious and his knowledge both broad and deep. At the time of his death, Melvyn had just completed an article on long-range photo-reconnaissance Spitfires for us, and we present it here in tribute to a longstanding friend and one of aviation's "true believers". Blue skies, Melv.

We also bid farewell — for now — to our *Ces Hommes Magnifiques* series by Jean-Christophe Carbonel. Don't worry, we will be continuing with articles that have a French flavour, as "JC" continues to trawl the archives for more weird and wonderful adventures by those magnificent Frenchmen — another of which, Monsieur Delprat and his flying house, also features in this issue. So, having stowed the crockery and shut the cat flap, it's away we go . . .

Nick Stroud

FRONT COVER ***A magnificent photograph by PETER LEWIS of Hawker Hunter J-4040 of Fliegerstaffel 15 in its special "Papyrus" colour scheme, with the Matterhorn as a backdrop, in 1994.***

BACK COVER ***The Westland WG.30 underwent trials as a battlefield helicopter, but progressed no further. Professor Keith Hayward's analysis of the Westland Affair starts on page 10.*** TAH ARCHIVE

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AIR CORRESPONDENCE

Letters to the Editor

A Rolls-Royce insider remembers

SIR — I always enjoy reading the very erudite articles from Prof Keith Hayward and, as I was personally involved 50 years ago, it was instructive to learn from *Collapse of an Icon* in *TAH34* what was happening way above my Rolls-Royce paygrade. However, although dates are mentioned, he doesn't record the date when I know R-R went into voluntary liquidation.

Thursday February 4, 1971, started as usual in the Design & Drawing Office at the Rolls-Royce Flight Test Establishment, Hucknall, but around mid-morning people found that the switchboard at Derby was not accepting calls. Before lunchtime came the unbelievable news that Royce's was bust! Total shock, but we should have seen it coming.

I was then in the Weights Department, dividing my time between calculating the weight and balance of the RB.211 Hot Stream Spoiler and the weight requirements of the Hucknall Flight Test fleet, including the VC10. We worked in close co-operation with the Costs Department and I remember being told, in 1970, that the company was going to lose £110,000 on every RB.211 delivered to Lockheed. My colleagues did not appear to be too worried, as they had had the same situation with the Avon, the Spey and the Conway, and engineering excellence had always won through. It didn't this time.

Finally, in mid-March, I and 4,000 other employees were made redundant. After almost ten years of Hospital Engineering in London and Cardiff, on February 4, 1981 (ten years to the day), I was being interviewed for a post then called Deputy to the Keeper of Duxford Airfield. Had Rolls-Royce not failed in 1971, I would never have got to Duxford.

David W. Lee *Kedington, Suffolk*

Rotors and propellers

SIR — On page 79 of *TAH35*, in Leif Hellström's *Sabena's Congo Ventilators*, there might be, at the very least, an oversimplification.

The photograph of Sikorsky S-55A OO-CWF is captioned with the reason for the accident being a structural failure, and in the text as the tail rotor having sheared off the boom.

To me, on first sight of the photo, the reason for the destruction of the aircraft was ground resonance and the boom has been severed by the main rotor. It'd be a pretty "magic" tail rotor to do that sort of damage.

I'm no helo expert and I do note that the tip of the boom is lying in the foreground, so maybe somehow the tail rotor chopped that bit off and the rest of the damage was caused by the subsequent loss of control.

In Matt Bearman's article on propellers, *The Other Sound Barrier* — though I did not understand all of it — I found it most interesting, and the comment about paddle blades caught my eye.

The Consolidated B-24 was originally fitted with "toothpick" blades, while paddle blades — the latter provided by Nash Kelvinator — came later. In B-24 circles this is accepted simplistically as providing improved performance at high level without explanation, but I wonder if the real reason was as per the explanation in the article, basically maintaining performance at higher level with the laminar-flow thicker blades allowing the speed at full-throttle height to increase and the engines not being slowed.

I shall have to discuss this with the more technically-minded of our group!

Bob Livingstone *Samford, Qld, Australia*

[It was indeed the main rotor that sheared the tailboom off — we inadvertently introduced an error during editing and didn't pick it up on the proofs; entirely our fault — Ed.]

The Queen twin & the Gould Prize

SIR — Following your publication of my article on the Gould Prize fiasco in *TAH33*, Errol Martyn in New Zealand has provided leads to information revealing the fate of the Queen twin monoplane.

The aircraft was not finished in time for the initially planned competition fly-off on June 1, 1911, but on July 5 that year American aviator Arthur Burr "Wizard" Stone, who was employed

as a test pilot with the Queen company, took the aeroplane out early in the morning. Having sped halfway around the field at Nassau at a height of 50ft and at an estimated 80 m.p.h., "something went wrong" (another report blames a "severe gust of wind", while another account states that it "jumped off the ground like a scared rabbit and almost immediately keeled over on one side") and the aircraft fell to the ground. Stone was thrown out on his head and required four stitches to a scalp wound; the aeroplane's forward engine was wrenched from its mounting and the front propeller and starboard wing were both badly damaged.

The accident was attributed in part to the rudder being too small, but it was reported that it would not take long to effect repairs. However, as the Queen twin evidently did not reappear for the postponed fly-off a year later, on June 1, 1912, it seems that that the company might have abandoned it by then. Additionally, the foregoing leads to the probability that my dating of the Queen photos in my article is awry, and that they might well have been taken months earlier than my captions suggest.

Philip Jarrett *Dorking, Surrey*

A gift well worth sharing

SIR — By chance, as a Christmas gift I received from my son-in-law (who is a professional photographer) a rare original photograph, printed from an old original negative, of Italian CANT 10ter flying-boat I-OLTE. The image was captured by Czech photographer František Beneš (who travelled worldwide with his camera) in Turin in September 1928. It was a SISA aircraft and may be of interest to fellow readers — the same machine was depicted in Part One of Maurice Wickstead's series *Italy's Forgotten Airlines* in *TAH31*.

Pavel Kučera *Prague, Czech Republic*

Whether to colourise — 1

SIR — Congratulations on *TAH34*. Plenty to read there — I went straight to the article on the airship *Roma*, and am now reading the rest in order. I would be quite happy to see more on lighter-than-air aviation.

You asked for feedback on the colourisation issue. I think your suggested approach is the right one, to use it sparingly and always make it clear if a photograph is colourised. Colourisation is pretty much a fact of life now and we cannot

This glorious photograph depicts CANT 10ter I-OLTE on a slipway at Turin in 1928— see Pavel Kučera's letter on this page. FRANTIŠEK BENEŠ

ignore it. We are having the same debate in Cross and Cockade. We need to appeal more to younger readers, and colourisation could contribute to this, provided we also educate them about the pitfalls.

It could be argued that black-and-white photos are the unnatural ones, as the past was not monochrome in reality. Sometimes there is talk about black-and-white being the photographer's original intention and we should not alter history; but, apart from the top professionals, most used monochrome film simply because it was all they had, and weren't that bothered about being artistic. The problem is to ensure that the added colour is accurate, which relies on judgment as well as good software. It would be very difficult to be sure of, for instance, the colour of a girl's dress, but the colours in photographs of aircraft are easier to interpret as it is often known what colour they were in reality. This is especially true of military or airline colour schemes, but less so with private aircraft. But there are still pitfalls. What were the colours on a German aeroplane of World War One, where Jasta pilots in particular were allowed to decorate their mounts in gaudy schemes? And the controversy about the exact shade of British PC10 and PC12 is not completely resolved. And with 1920s RAF types, there was a transition from white to silver, and it is very difficult to tell from photos which of these is being portrayed.

So, I would be happy with you continuing your current approach and be selective about which photos can be worked on accurately.

Adrian Roberts *West Wickham, Kent*

Whether to colourise — 2

SIR — You've kicked off something of a debate, haven't you! I must admit I was taken in by the *TAH35* cover shot [**INSET BELOW**, with similarly colourised *TAH33* cover], although I did wonder (just for a moment) how that Connie's Dural skin could be rusting, as it appeared to be.

It's nice to have an eye-catching image, especially on the cover — but in adding colour to a black-and-white image the artist is adding information that just isn't there in the original photograph. It's a bit like padding out an old document with stuff that went unrecorded — the activity that distinguishes the historical novelist from the historian. This is not to say that where there's a good body of evidence (in our world, known airline and military schemes, preserved sections of fabric and so on), judiciously colourising black-and-white pictures can give something very close to the truth. However, as more and more of the picture is made up of guesswork — what colour was that passenger's coat? his hair? her eyes? — a further degree of fiction creeps in.

In a different but not entirely unrelated subject, in the same edition you have some great images of the Focke-Wulf Fw 190s of JG 2 *(Dieppe: The Luftwaffe Perspective)*. Several of these appear to have been shot on unusually wide-angle lenses for the 1940s (notably the one of Egon Mayer's '190 being refuelled, page 116) and look quite "modern". This is just a guess on my part, but I think the reason may be that the photographer was using a Zeiss Contax camera fitted with a 28mm Tessar lens. At the time, the Leica — the rival camera everyone knows today — went no

Sent in by* TAH *subscriber and self-confessed "sad shutterbug" Philip Whiteman, Editor of* Pilot *magazine, these images show* BELOW LEFT *a 28mm Tessar lens and* BELOW RIGHT *his Contax cameras. See letter on these pages.

Stratospheric surveyor "*en miniature*"

We love it when* TAH *articles (in this case* Tragique: The Sud-Est SE.1010 *in* TAH25*) spark modelling projects. This photo came from Derbyshire subscriber David Hart: "Like many of my models, this is a 'kit bash' of the old school (think mid-'60s* Airfix Mag*). The fuselage owes something to a 1/100th-scale Tamiya Ilyushin Il-28 and Milliput filler. The wings started life as part of a 1/144th-scale B-17 from Crown; the engine nacelles started as part of a Minicraft KC-97, while the propellers are white-metal items from Welsh Models, intended for an Avro York. I see this as very much a sketch of the aircraft; I am visibly not a rivet-counter". Merveilleuse!

wider than 35mm, and Zeiss's camera and lenses were widely reckoned to be superior, offering unmatched speed and quality. Indeed, on the Allied side, photographer Robert Capa used a Contax to shoot his famed D-Day landing images.

The attached pics show a Tessar lens (Googled image) and my own couple of the Contaxes I own — the 1937 one on the left is a British/American market one, with the focusing scale marked in feet, the 1939 one is the German/European market version, with distances marked in metres. Both are fitted with contemporary uncoated lenses.

Philip Whiteman *Editor,* Pilot *magazine*

Colourist Richard Molloy responds:

Any colourised image is an artistic interpretation of the subject and should be taken as such. I mark all my work as colourised and* TAH *does too. Obviously as colourists we try to be as accurate as possible; but, just as any painting or illustrations can have errors, so colourised images can have errors too, or artistic licence. I gave the* TAH35 *cover image some weathering, which has been interpreted as rust, but in this instance I was just trying to give the impression of an aeroplane that wasn't box fresh.

The question to colourise or not to colourise an image will always divided the crowd, I guess. But I hope people will realise they are just works of art and not to be taken as historical evidence — although we obviously take every care to make them as accurate as possible.

[And, while always striving for historical accuracy,* TAH *is eternally mindful of the need also to engage and entertain our readers. Arresting cover images are a part of that — Ed.]

Buccaneering by road

SIR — I was fascinated to see *Off the Beaten Track* in *TAH33,* featuring Buccaneer S.2B XW530 at the petrol station in Elgin. This aircraft was the first Buccaneer built exclusively for the RAF. All the Buccaneers inherited by the RAF from the RN had serials in the range XN, XT and XV. The new-build ones were all XW, XX and XZ. I never flew XW530, as it must have gone to one of the Germany-based squadrons where most of the new build went. I note that when I was on No 12 Sqn, 1972–75, all our aircraft were ex-RN.

I understand that when XW530 was to be towed down the road from Lossiemouth to Elgin the local road authority insisted on a qualified Buccaneer pilot being in the front seat, despite there being no seat installed and no braking facility. A local retired ex-RN pilot volunteered to do the job, sitting on a box but unable to influence events in any way. The roads authority were satisfied and I'm glad the Buccaneer is still there.

Gp Capt Tom Eeles *Great Ashfield, Suffolk*

[Buccaneer XW530 was towed from RAF Lossiemouth to Elgin on September 10, 1995 — not "circa 2002" as we originally thought. In the cockpit was retired Buccaneer pilot Ian Aitchison, by then a civilian instructor in Lossie's Tornado simulator. Ian was joined in the aircraft, according to local newspaper reports, by 13yr-old enthusiast William Neish. Despite our best efforts, and those of Elgin-based* TAH *subscriber Dale Clarke (thanks, Dale!), we have not been able to obtain a good-quality photograph of the aircraft under tow with Ian and William aboard. If anyone can supply one, please get in touch! — Ed.]

THE WESTLAND AFFAIR

. . . and the origins of UK aerospace globalisation, 1985–95

Continuing his series on some of the most significant post-war political issues faced by the UK aerospace industry, **Prof KEITH HAYWARD FRAeS** turns his attention to the infamous crisis of 1985–86, which, along with several other issues, including the failure of the Nimrod AEW.3, wrought far-reaching changes in the structure of the UK's defence industrial base

THE NOTORIOUS so-called "Westland Affair" of 1985–86 very nearly brought down the Conservative government of Margaret Thatcher. It was undoubtedly one of the most dramatic political events of the period, made more so by the resounding clash of personalities and the exercise of the darker political arts that shaped details of the crisis. It was perhaps accidental that an aerospace company was at the heart of this affair — but, stripping away some of the more egregious political elements, there were important principles at stake that had direct consequences on the UK's aerospace and defence policy; principles and consequences that would affect the next quarter-century of the nation's aerospace development. On the one hand, it would confirm a more austere approach to procurement, but on the other it suggested a fundamental shift in political attitudes to both inward and outward investment in the sector and what constituted the UK's Defence Industrial Base (DIB). This might imply a story of dry financial affairs and the minutiæ of procurement policy, but in reality it marks the start of the globalisation of the UK's defence and aerospace industries.

Globalisation suggests a deeper penetration of a national defence and aerospace base than the interdependence of partners in a collaborative project, such as the helicopter programmes Westland developed with the French during the 1960s or the multinational Panavia Tornado project of the 1970s. It is effectively the creation of transnational enterprises, in which ownership

TAH ARCHIVE

ABOVE ***The WG.30 — later referred to as the Westland 30 — was a development of the company's Lynx military helicopter, with which it shared 85 per cent of its components, incorporating a more capacious cabin for predominantly civil operations. The prototype, G-BGHF, seen here, made the type's maiden flight on April 10, 1979, two weeks ahead of schedule.***

and control passes wholly or in large part to a foreign company. Even before the Westland Affair of 1985 there had been some examples of this in the UK, but foreign ownership and control specifically was the issue at stake in the autumn and winter of 1985–86.

SETTING THE SCENE

In some respects the post-1945 story of Westland is the history of UK aerospace in microcosm, albeit with a touch more success than many of its post-war contemporaries. Emerging from the war with a mixed record of fixed-wing developments, Westland's management spotted an opportunity to produce helicopters under licence from American manufacturer Sikorsky. This went against the grain of contemporary UK government policy, which focused on developing indigenous designs as part of an autonomous "rotary-wing industrial base".

The company's American-designed products, incrementally improved by domestic innovation, attracted important customer support, especially from the Royal Navy. By 1960 and the regrouping of the UK aircraft industry, five out of every six helicopters in the UK had been built by Westland at Yeovil. The company's commercial success made it the obvious focus for UK helicopter development and production, and by 1961 Westland had absorbed the rotary-wing interests of Bristol, Saunders-Roe, de Havilland and Fairey.

Westland benefited from the government's promise to concentrate orders on the newly organised groups; but, as with the fixed-wing industry, domestic demand alone was insufficient to sustain increasingly expensive development costs. The Plowden Report of 1965 pointed to European collaboration as a solution to this problem and an Anglo-French "package deal" signed in 1967 led to the development of the Lynx, Gazelle and Puma military helicopters. However, the French failed to take up the armed-escort element of the Westland-designed Lynx, and, while the package was a commercial success, the British company lost a large part of the promised production run. *[See Chris Gibson's* What's French For Fait Accompli? *in* TAH28 *— Ed.]*

Despite this bruising experience, Westland signed up to a general European Memorandum of Understanding (MoU) in 1975, which was followed by another round of collaborative programmes in 1978. This was promoted by the Labour government as a way of building up a European rotary-wing sector able to stand up to the Americans. This resulted in Westland signing up with Italian company Agusta to develop two aircraft, one of which became the EH101, later developed into the Merlin. Less successfully, Westland, backed by government "launch aid" (essentially subsidisation in return for a share of future profits), started work on the Westland 30 (aka WG.30), a development of the Lynx aimed predominantly at civil markets.

Westland was left out of Labour's aerospace nationalisation programme; there were concerns that its inclusion may have left it exposed to any British Aerospace (BAe)-inspired rationalisation. This meant that Westland was something of an anomaly in the world helicopter industry — a

LEFT ***"The company-doctor who never lost a patient" — Sir John Cuckney was appointed Chairman of Westland in 1985, having established himself as a tough no-nonsense industrialist during his previous chairmanships with Mersey Docks and Port of London Authority during the 1970s. Cuckney had served with MI5 after the war, leaving to work in the City in 1959.***

standalone specialist. It did have other aerospace interests but by 1985 helicopters represented two-thirds of its turnover. As the House of Commons Defence Committee noted: "Westland lacked the resilience of the other [foreign] producers. Westland's worsening problems in 1984 and 1985 therefore had a direct effect on its viability".[1]

Westland was thus vulnerable to a widespread collapse in demand in the early 1980s. It had to carry a heavy loss on the WG.30, and its order book to 1990 was sparse. Military interest in the WG.30 in the UK waxed and finally waned. In 1982 Sikorsky proposed a renewed partnership to build S-70/UH-60 Black Hawks for the Ministry of Defence (MoD), a proposal finally ruled out by Michael Heseltine, Secretary of State for Defence, on budgetary grounds.

Co-operation on the WS.70 Black Hawk formed a central part in British helicopter pioneer Alan Bristow's bid for Westland in the spring of 1985. By the summer of that year, however, Bristow had backed out, citing the manufacturer's poor financial condition and a refusal by the UK government to refinance the WG.30. The government accepted that a last effort should be made to avoid bankruptcy for Westland. The appointment of new Chairman Sir John Cuckney came with a clear brief to make the commercial judgments necessary to save the firm. The only assistance forthcoming from the government was to write off the launch-aid payments for the WG.30 and to "leave the company to find its own solution to its problems through the market".[2]

Leon Brittan was appointed Secretary of State for Trade & Industry in September 1985, but his tenure was short; in January 1986 he resigned in the wake of allegations of leaking the Mayhew letter during the Affair.

In November 1985 Cuckney proposed to offer 29·9 per cent of the company to prospective buyers; when no British offer was forthcoming, he concluded that a combined offer from Sikorsky in the USA and Fiat in Italy would be the best way forward. This would have effectively ended British helicopter design independence.

So far neither the MoD nor the Department of Trade & Industry (DTI) had expressed any opposition to Westland passing into foreign hands. The link with Sikorsky and its well-funded parent, United Technologies (UT), would provide both funds and market access. Sikorsky would provide an *entrée* into the European market, giving Westland the right to sell Black Hawks in Europe, as well as a significant cash injection. Had it been successful, it might have filled a gap in production until the EH101 came on stream.

TENSIONS RISE

An alternative European approach was supported by National Armaments Directors (NADs) in Europe as the basis for a pan-European helicopter company that might compete more effectively against its American counterparts. Heseltine was also authorised to "explore the possibility of an acceptable proposition by a consortium of European companies to rescue Westland". Heseltine advocated a UK-sponsored alternative, comprising BAe and GEC-Marconi, along with Aérospatiale in France, Messerschmitt-Bölkow-Blohm (MBB) in West Germany and Agusta in Italy. However, as the Secretary of State for Trade & Industry, Leon Brittan, told the Cabinet on December 19, 1985, the government would not be bound by "recommendations from the NADs".

More importantly, while a formal offer had been made by BAe on December 13, the "directors of Westland had not regarded it as sufficiently firm or attractive", and would be recommending the UT/Fiat bid to its shareholders. It was up to Westland to make the best decision on behalf of its employees and shareholders. Moreover, Brittan asserted, "ministers should not be drawn

ABOVE ***Appointed Secretary of State for Defence in January 1983, Michael Heseltine enjoyed a cordial relationship with Margaret Thatcher until January 1985, when he insisted that two Royal Navy frigates be built at Cammell Laird rather than the cheaper Swan Hunter. Furious, Thatcher became determined to keep future defence costs down by buying American.***

into public comment on the competitive merits of the two proposals". This was a clear shot across Heseltine's bows. But, as the minister responsible for procurement, Heseltine had a duty to answer as he saw fit on the question of future orders and an important MoD supplier. For her part, Prime Minister Thatcher emphasised the importance of "collective responsibility" — "no minister was entitled to lobby in favour of one proposal rather than another".[3]

The situation thus boiled down to a straight fight between a European consortium led by BAe incorporating Aérospatiale, MBB and Agusta, and an American-European grouping of UT/Sikorsky and Fiat. Sikorsky had the implicit backing of Brittan and Thatcher, who publicly took a neutral position on the affair. Heseltine now came out publicly for the European option and began to declare a more open advocacy of a BAe-led bid. Cuckney and the Westland board much preferred the more substantive offer from Sikorsky/Fiat; many in the company felt that Aérospatiale's concern for the future of the company was triggered only by the threat to its interests posed by Sikorsky.[4]

POLITICAL BECOMES PERSONAL

At this point the issue began to assume a more personal dimension, with Heseltine increasingly resistant — demonstrably so — to the American-led offer. Although Heseltine won some support from members of the House of Commons Defence Committee, it was evident that by Christmas 1985 Thatcher's patience was wearing thin and she was evidently annoyed that such a relatively small company was creating so much controversy.

In January 1986 the politics became even more personal. Cuckney wrote to Thatcher asking for assurances about future European business. This was forthcoming in her reply:

"It has naturally been the government's concern that a British helicopter design, development and manufacturing capability should, if possible, be maintained, despite the present difficulties of your company. I understand that both the proposals Westland now have under consideration are intended to achieve that objective. As long as Westland continues to carry on business in the UK, the government will of course continue to regard it as a British, and therefore European, company, and will support it in pursuing British interests in Europe.

"Government policy will remain that the United Kingdom should procure its helicopters from the most cost-effective source. Against this background, the government would wish to see Westland play a full part in existing and future European collaborative projects. And I can assure you that, whichever of the two proposals currently under consideration the company chooses to accept, the government would continue to support Westland's wish to participate in [European] projects and would resist to the best of its ability attempts by others to discriminate against Westland."[5]

At this point Thatcher and some of her other colleagues, including Brittan, began to consider

LEFT ***If looks could kill — Heseltine and Thatcher at an event in the mid-1980s, before the two fell out in spectacular fashion over Westland. After his resignation Heseltine returned to the back benches until Thatcher's departure in 1990, at which point he returned to Cabinet as Environment Secretary under John Major.***

BELOW ***A line-up of Westland's wares at the SBAC show at Farnborough in September 1984, including WG.30 G-EFIS (c/n 014), a pair of Lynx 3s and one of two Sea Kings exhibited at the show. By this time Westland was already in financial difficulty.***

dismissing or forcing Heseltine to resign over his campaign in favour of a European solution. Some of Thatcher's key aides, primarily Charles Powell and Bernard Ingham, pressed for a Cabinet-level ultimatum. They were apparently behind the leaking of a crucial letter from the Solicitor General, Sir Patrick Mayhew, which seemed to undermine Heseltine's case, and urged forcing him to "shut up or quit" at a Cabinet meeting scheduled for January 1986.

Thatcher was advised officially to stem the lobbying and counter-lobbying on behalf of the two bids for Westland and allow the company the freedom to choose between the BAe-led offer and the tie-up with Sikorsky. This put Heseltine on notice that further public advocacy, or even internal promotion of the BAe/European option, would be a resignation issue. Thatcher was also accused of applying pressure to Sir Raymond Lygo, BAe's Chief Executive Officer, to row back on the European offer.[6]

The Cabinet met on January 9, 1986, hoping finally to resolve the future of Westland, and, if Mrs Thatcher's aides were clever enough, to force the Defence Secretary's hand. Thatcher began by reviewing the state-of-play.[7] She reiterated the government's formal neutrality between the two bids and made it clear that no minister should actively lobby on the issue. However, she noted that over Christmas and into the new year, the government had attracted considerable criticism, "even from newspapers normally favourable to the government". This was politically damaging at a time when the government had begun to recover "some of its lost esteem". This was a clear demonstration of the damage caused by breaches of "collective responsibility" within the Cabinet. The latter should now agree "in full" to the conclusions from the December 19 meeting.

Brittan reported that both contenders had improved their offers since December, but that the Westland board had not modified its position and was still recommending acceptance of the Sikorsky/Fiat bid. Heseltine conceded that this had markedly changed the circumstances and that he had no intention of publicly declaring in

MIKE HOOKS

TAH ARCHIVE

ABOVE ***A military variant of the WG.30 was developed by Westland as a potential utility helicopter for the Army, which saw the type as offering similar capability to the RAF's Pumas (which provided the Army with airlift capability on the battlefield) but with an attractive servicing compatibility with its own Lynx support helicopters. It did not proceed, however.***

favour of one bid or the other. The government, he declared, "should put itself above the battle". However, if the Cabinet was simply to reiterate its position based on the December 19 meeting, "it would look as if the Cabinet was backing the board of directors of Westland". He contended that it looked as though the shareholders were only getting the one option. His colleagues were of the opinion that the company should be left to choose as it saw fit, a view endorsed by the Prime Minister, and it was imperative that any ministerial briefing or statement must be cleared by the Cabinet Office, "so as to ensure that all answers given were fully consistent with the policy of the government".[8]

HESELTINE DEPARTS

The Defence Secretary immediately bridled at this order, arguing that if he had also to confirm past statements, "it could create an extremely difficult situation, particularly for the European consortium, if [I] was not able to confirm them without delay. Any delay would give the impression of hesitancy or uncertainty, which could prejudice the commercial situation". Heseltine evidently felt that silence favoured the *status quo* that had been created by Westland's unwavering endorsement of the Sikorsky/Fiat offer. He felt personally exposed by earlier statements that may have shaped the European offer, that he could no longer repeat or confirm without clearance. He was, of course, willing to accede to these procedures as far as any new statement or briefing was concerned.[9]

His colleagues, however, remained faithful to the line put down by the Prime Minister, accepting no concession to past statements. Following a formal recapitulation of these procedures, Heseltine complained that there had been "no collective responsibility in the discussion of this matter. There had been a breakdown in the propriety of Cabinet discussions. [I cannot] accept the decision recorded in the Prime Minister's summing up. [I] must therefore leave this Cabinet" .[10] And so he went, out into Downing Street and out of the Thatcher government.

Heseltine's stand against the Sikorsky/Fiat bid was always likely to be personal; he and Thatcher were increasingly at odds over several issues, especially Europe. He had long advocated encouragement of pan-European aerospace companies. More directly, his leadership ambitions were becoming increasingly apparent. The question of how much Thatcher was personally involved in the plot to oust Heseltine is still unclear; but, according to her official biographer, "her hands were not entirely clean".[11]

Thatcher survived the Westland Affair, helped to some extent by a lacklustre performance by the Labour opposition in the crucial censure debates that followed in February. The Sikorsky/Fiat deal went through, accompanied by some last-minute dealings with Bristow over his holdings. The agreed 21 per cent share was large enough to give Sikorsky a "close involvement in the day-to-day policy and practices of the company".[12]

The partnership with the Americans (and Fiat)

TAH ARCHIVE

ABOVE ***Although the prospect of licence-building Sikorsky's UH-60 Black Hawk utility helicopter was seen as a major attraction as part of a potential Westland/Sikorsky merger, in the event only two examples of the WS.70 Black Hawk, as the UK version was designated, were built; the first, ZG468, seen here, ultimately went to Bahrain.***

undoubtedly gave Westland some breathing space and saved some key technologies, such as work on high-speed rotors. In 1987 Cuckney went on to cut capacity in the company in response to continued hard times and "previous over-manning and restrictive practices". His actions were "unavoidable and regardless of the level of orders which the government might realistically place", and were not linked to the decision to pull out of the European NH90 programme.[13]

In 1994, again facing deep financial problems, Westland was taken over by British industrial giant GKN, which had already inherited a small stake in Westland through part-ownership of Normalair-Garrett Ltd. The sale to GKN effectively acknowledged that there was little prospect of additional sales of the WS.70 Black Hawk, despite the apparent promise held out at the time of the Sikorsky bid.[14] With its Italian joint-venture partner Finmeccanica (now Leonardo), GKN turned Westland around, and in 2004 sold its entire share to Finmeccanica. Given that the original controversy was over loss of control to an American company, Westland's ultimate incorporation into one of two European helicopter manufacturers must at least provide Heseltine with some sense of vindication.

From an aerospace perspective, and stripping the crisis of its dramatic political overtones, the Westland Affair has a wider significance. With the benefit of hindsight and the consideration of some other procurement choices during the Conservative administrations up to 1997, a key factor was the extent to which the government became relaxed about elements of the UK DIB passing into foreign hands.

Heseltine took this one stage further; his concern was the extent to which American investment and control over key British defence assets would undermine European competitiveness and Europe's ability to resist American domination of key aspects of weapons development and production. Leon Brittan, and by implication, Mrs Thatcher, took a narrower commercial perspective; Cuckney had no reservations about the fact that the Americans had made the better offer and that control by BAe would have offered a more uncertain future. The House of Commons Defence Committee had no doubt that the government "as a whole" had seen no "compelling national interest in Westland choosing a European solution".[15]

ALARM, HARM & NIMROD AEW

Even before the Westland Affair, an earlier procurement decision, regarding the choice of a defence-suppression missile, had anticipated some of these issues. In 1982 BAe Dynamics/GEC-Marconi's proven air-launched anti-radiation missile design ALARM was competing against an existing American system, Texas Instruments' HARM. Heseltine was a forceful advocate of the British option. Despite Texas Instruments teaming with British company Lucas Industries to produce the missile onshore, the key issue in Heseltine's view was the technological implication of the choice, primarily the missile's radar seeker. The UK, he stated, "could not afford

TAH ARCHIVE

ABOVE ***The BAe Nimrod AEW.3 was conceived as a homegrown airborne early warning system similar to Boeing's E-3 AWACS, modified from standard Nimrod MR.1s. The first production version, XV285, seen here, first flew in March 1982. Only 11 examples were built and the project was cancelled in favour of the E-3 in December 1986.***

to be without this technology". GEC-Marconi was the only British company with "a major capability in this area". Its loss would threaten any co-operation in the sector with the Americans and undermine Britain's ability to "develop and manufacture complete systems". A research and development (R&D) programme alone — the Treasury's proposal — was not enough.

The Chancellor of the Exchequer, Sir Geoffrey Howe, countered with financial arguments, claiming that BAe Dynamics was offering ALARM as a "loss leader", with speculative financial backing for a weapon that had few export prospects. For its part, BAe was gambling on the fact that the government would not allow it to fail. HARM, on the other hand, had "a real prospect of securing export orders".[16] In the event, although more costly, ALARM proved to be the better system, albeit with few export sales. It did help to maintain a key industrial asset, which, like Westland, later formed the basis for a successful European missile company (MBDA).

The decision to cancel the BAe Nimrod AEW.3 airborne early warning system in 1986 had similar features. However, the huge cost escalation and technical uncertainties that still surrounded the ALARM programme made this a more straightforward case. The Thatcher government inherited the Nimrod AEW programme, which was already severely delayed, with costs rising rapidly. In 1986, with the AEW.3 still far from offering a satisfactory system, the MoD launched a comprehensive review of AEW options, including the Boeing E-3 AWACS. As the latter was the Nato choice and based in the UK, it offered both a convenient and cheaper alternative to the Nimrod AEW. However, it would not directly promote UK DIB interests.

By the end of 1986 governmental patience with the Nimrod AEW project had finally run out, and that December the Cabinet cancelled it in favour of the E-3D, with necessary industrial offset from the Americans to compensate loss of business to UK companies following the Nimrod cancellation.[17] The needs of the military customer had to take precedence over domestic industrial concerns. In the final analysis, "the customer must ultimately decide which product to purchase", opined the Cabinet, and the Nimrod had failed that test.[18] At the time of cancellation, the government wrote off more than £1bn in sunk costs.

THE SHIFT TO A GLOBAL VIEW

By the late 1980s the questions arising from these procurements had expanded into a generalised debate about what comprised the essentials of the UK's DIB and the extent to which government policy, specifically MoD procurement decisions, should actively defend that base.[19] The Conservative government, backed by many in the MoD, took a narrow view of what they deemed to be vital technological and industrial interests worth defending. Most of these turned out to be related either to nuclear capability or cryptography. Officially, ownership of other defence and aerospace assets did not matter as long as they were *located* in the UK (author's emphasis). The key criterion was

TAH ARCHIVE

ABOVE ***Westland's prospects for the 21st century improved greatly with the joint development (with Italian company Agusta) of the EH101, later to become the AW101 Merlin, the fourth pre-production example of which is seen here in 1993. The Merlin will continue to serve with the Royal Navy until the end of the 2020s.***

"value for money", which could be delivered by the application as far as possible of competitive procurement. The corollary of this position was that companies such as Westland had an untrammelled "right and responsibility" to make their own commercial judgments.[20]

None of these developments was explicitly for or against a European or American preference. There were a number of procurement choices that would favour the latter, including the decision to buy the AH-64 Apache attack helicopter rather than its European rival, the Eurocopter Tiger, in 1995. On the other hand, the Thatcher government backed the European Fighter Aircraft (EFA — origin of the Eurofighter Typhoon), a crucial moment in late 20th-century British aerospace history. (As an aside, she also authorised launch-aid for the Airbus A320, perhaps the most important event in the civil sector.)

The important shift — one which would clearly differentiate the UK from most of its European neighbours, certainly the major defence and aerospace producers — was the relaxed attitude towards inward investment and the loss of national ownership of important industrial assets. This characteristic would last into the next century, with several significant elements of the UK aerospace and defence industries passing into foreign ownership. Yet this cleared the way symbolically and politically for UK outward investment in foreign, notably American, defence and aerospace companies. There were earlier examples, such as GEC-Marconi's entry into the American defence-electronics sector starting in the 1980s; but the takeover of the Allison Engine Company by Rolls-Royce in 1995 and BAe's acquisition of GEC-Marconi's defence business — in part a defensive measure to head off further American penetration of the UK/European market — which included significant American holdings, marked a major shift towards the globalisation of the UK's DIB.

There may not have been a direct causal link between this transformation and the Westland Affair, but the willingness on the part of a British government to allow a loss of national control over a strategic asset began the dilution of ownership as a determining feature of government policy towards the sector. And if the domestic market was no longer to be protected, as BAe concluded, it was better perhaps to take the offensive and expand overseas.

1 Cited in Hayward, K., *The British Aircraft Industry*, Manchester University Press, 1989, p169
2 Cabinet minutes, January 9, 1986, The National Archives (TNA) ref CAB/128/83/1
3 Cabinet minutes, December 19, 1985, TNA CAB/128/81/37
4 Hayward, op cit, p170
5 Letter to Sir John Cuckney, January 2, 1986, Margaret Thatcher Foundation Archive (www.margaretthatcher.org/archive)
6 Travis, A., quoting Charles Moore, in "Revealed: Thatcher aides campaigned against Heseltine over Westland affair", *The Guardian*, February 19, 2016. This article was based on the delayed release of Cabinet papers. Later in January 1986, when details of this breach of the ministerial code became known, Brittan was forced to resign. By then Heseltine had already gone
7 Cabinet minutes, January 9, 1986, TNA CAB/128/83/1
8 Ibid
9 Ibid
10 Ibid
11 Travis, op cit
12 House of Commons Defence Committee, 1985–86, HC518, para 129
13 Cabinet minutes, April 9, 1987, TNA CAB/128/85/14
14 My appreciation to Dr Ron Smith for this observation
15 HC 518, op cit, para 173
16 Cabinet minutes, 26th July 26, 1983, TNA CAB/128/76/25
17 Cabinet minutes, December 18, 1986, TNA CAB/128/83/42
18 Ibid
19 This debate was described in Taylor, T. and Hayward, K., "The UK Defence Industrial Base: Issues and Options", *RUSI Journal*, Vol 134, Issue 2, 1989
20 "Westland plc", government response to House of Commons Reports HC 518 and 519, October 1986, HMSO Command Paper 9916, para 26

THE ORIGINAL PHOTO BOMBERS

THE BOEING RB-29 & THE BIRTH OF STRATEGIC AIR COMMAND GLOBAL RECONNAISSANCE

Despite the extraordinary advances in aeronautical technology in the immediate post-war period, the USAAF's newly established Strategic Air Command nevertheless had to depend on one of its tried-and-trusted wartime stalwarts to fulfil the vital strategic reconnaissance role. **BILL CAHILL** chronicles the SAC career of the Superfortress's reconnaissance variant

ABOVE ***By the time he was appointed first commander of the newly formed Strategic Air Command (SAC) in March 1946, General George C. Kenney had established a reputation as a politically and tactically adept leader while in command of the Far East Air Forces (FEAF) in the South West Pacific Area during 1942–45.***

USAF / SAC BADGE JUANITA FRANZI

STRATEGIC AIR COMMAND (SAC) was established by the US Army Air Forces (USAAF) on March 21, 1946, acquiring a portion of the personnel and facilities of the Continental Air Forces, the wartime Command tasked with the air defence of the continental USA. The few reconnaissance aircraft that remained available to SAC after the post-war drawdown had to prove their usefulness in an era of austerity, so SAC Commander Gen George Kenney focused his efforts on activities such as the Post Hostilities Mapping Program, that could benefit the growing commercial aviation sector instead of monitoring would-be adversaries.[1] One asset SAC used in this activity was the Boeing F-13.

THE PHOTO SUPERFORTRESS

On April 7, 1944, requirements had been established for a Boeing B-29 Superfortress modified to perform photo-reconnaissance missions, with delivery somewhat optimistically set for September 19 that year. Accordingly, production B-29s were sent to the Denver Modification Center in Colorado, where the bomb bay was sealed and extra fuel tanks added. A camera section was built in the aft pressurised section of the fuselage behind the central fire-control station to accommodate a single vertical camera, a split-vertical two-camera assembly and a trimetrogon camera assembly. The 188 so-modified B-29BWs and B-29As were redesignated as F-13s, using the "F for photo" designation of the era.[2] In 1948 the designation would change to RB-29.

The first F-13s were scheduled to be delivered to the 3rd Photographic Reconnaissance Sqn (PRS) to support the Twentieth Air Force's strategic campaign against Japan. The squadron completed training and flew its first operational mission from Saipan on November 1, 1944. In the ten months the 3rd PRS was part of the Twentieth Air Force it flew 450 imagery and 42 signals-intelligence (SIGINT) missions, the latter using specialised Consolidated B-24 *Ferret* aircraft.[3] *[For more on* Ferret *operations see the author's* The USAAF's Mediterranean Ferrets *in* TAH30 *— Ed.]* Similar in form and function to the 3rd PRS, the 1st PRS was scheduled to transition to the F-13 in Kansas before deploying to the Pacific to support XX Bomber Command of the Eighth Air Force, but the war concluded before the unit completed its training.[4]

After hostilities ceased, the 3rd Reconnaissance Sqn, Very Long Range (having been redesignated on September 19, 1945) flew Post Hostilities Mapping Program missions throughout the western Pacific until the call came to disband in March 1947.[5] The 1st RS deployed to Okinawa in September 1945, being assigned to the Far East Air Forces' Thirteenth Air Force in the post-war shuffle in November. The 1st RS flew mapping missions over China, Japan, Okinawa and Formosa (Taiwan) until it too was disbanded in March 1947. The F-13s of the 1st and 3rd RSs were probably assigned to the 31st RS, activated in October 1947 to continue mapping for the Fifth Air Force.[6]

The Post Hostilities Mapping Program in Europe was undertaken as part of Project *Casey Jones*, using two ex-Eighth Air Force Bomb Groups (BGs) equipped with Boeing B-17Gs modified for

A Boeing RB-29 of the 31st Strategic Reconnaissance Sqn (SRS), 5th Strategic Reconnaissance Wing (SRW), has its Wright R-3350 engines run up at the end of the runway before a training mission from Travis AFB in California in May 1951. The photo-reconnaissance variant of the B-29 was initially designated F-13, but was redesignated RB-29 in line with organisational changes for the newly-formed USAF in 1948.

AFHRA VIA AUTHOR

AFHRA VIA AUTHOR

ABOVE ***The USAAF's 3rd Photographic Reconnaissance Squadron, Very Heavy, first took its F-13s into combat on November 1, 1944. The unit lost only three aircraft in more than nine months of combat flying. This example, 42-24621*** **Yokohama Yo-Yo,** ***was photographed between missions on June 7, 1945, while based on Guam.***

the task and aided by the B-17/F-9-equipped 19th Photographic Mapping Sqn.[7] The post-war mapping effort in the USA was handled by the F-9s and F-13s of the 16th Photographic Sqn, while the F-9-equipped 91st RS covered South America. These two units were soon aligned under the control of SAC.[8] Although mapping was useful from a war planning standpoint, there still existed a need to support the strategic forces; although limited in resources, SAC was still able to assign F-13s to this critical tasking.

THE COMMUNIST THREAT

Hostilities with Japan had concluded less than six months before the USAAF started flying reconnaissance missions against the Soviet Union. In late 1945 the 404th Bomb Squadron (BS), a B-24-equipped Alaska Command unit flying from Shemya in the Aleutian Islands, flew ocean surveillance as well as SIGINT missions against the Soviet Far East using one of the late-war "production" B-24M *Ferrets* before the unit was disbanded on January 5, 1947.

What was needed for war planning was Arctic mapping, and for this SAC turned to the 46th RS. Personnel were not assigned to this "paper" organisation until June 1946; two months later the unit deployed to Ladd Field, Alaska, and was transferred to Alaska Command. Equipped with B-29s and F-13s, the squadron conducted a geodetic survey of the Arctic region and perfected long-range grid navigation. The unit was also tasked with a secondary mission of assessing the Soviet threat from international waters.[9]

Activated when SAC was stood up in March 1946, the 311th Reconnaissance Wing (RW) was tasked with undertaking photographic and reconnaissance missions within the USA and overseas for SAC and USAF Headquarters.[10] While the Wing executed its mapping mission through subordinate units like the 16th and 91st RSs, it also supported atomic tests in the Pacific. Ten F-13s supported Operation *Crossroads* nuclear testing at Bikini Atoll in 1946, integrating into Joint Task Force One to provide imagery support from eight aircraft, as well as radiological reconnaissance from two modified F-13s.[11]

Reconnaissance activities against the Soviet Union started to tick upward, but the effort was fractured. USAF forces in Europe modified B-17s to fly SIGINT missions against the Soviets in the Baltic region. This activity drove the Aircraft Radio Laboratory at Wright Field in Ohio to modify a B-29 into a *Ferret* radar-reconnaissance aircraft in early 1947. Stripped of armament and crammed with electronic equipment and six operators in the fuselage aft of the bomb bay, the aircraft departed Ohio for Alaska on May 17, 1947. The aircraft flew eight operational missions against the Soviet Chukotski Peninsula before returning to the USA (Alaska was an incorporated territory of the USA at that time, not becoming a state until 1959).[12] The aircraft then deployed to Europe in September and flew a mission along the "Berlin

AFHRA VIA AUTHOR

ABOVE ***A pair of RB-29s of the 1st SRS, 55th SRW, flying in formation during a training sortie over the USA in May 1949. The 1st SRS was reassigned to the 9th SRW the following month and began passing its RB-29s on to newly formed units in November that year, as the unit began its transition to the mighty Convair RB-36 Peacemaker.***

corridor".[13] The activities of the prototype B-29 *Ferret* highlighted the need to build a larger reconnaissance force — but that would take time.

During 1947–50 USAF Air Materiel Command (AMC), working to SAC's requirements, specified and procured the aircraft that would constitute SAC's reconnaissance force until the late 1950s. Developmental challenges troubling the planned strategic-reconnaissance aircraft, the Republic XF-12 Rainbow, opened up the field to a modified bomber platform.[14] Eventually, two bomber aircraft in the procurement pipeline, the Convair B-36 and Boeing B-47, would be modified to produce reconnaissance variants; in the near-term, reconnaissance variants of the Boeing B-50, an outgrowth of the B-29, would also be acquired.[15] Acquisition delays left the burden of day-to-day reconnaissance on the ageing RB-29 fleet. To increase the utility of the RB-29s in their new mission of stand-off reconnaissance in international waters, SAC had to modify its fleet.

The B-29 *Ferret* prototype had provided proof-of-concept for a new breed of SIGINT aircraft based on the B-29. Design work was completed in late 1947 and the conversion of ten stored B-29s into RB-29AE *Ferrets* commenced in early 1948.[16] Another RB-29 modification involved the installation of a 100in focal-length camera to provide photo-reconnaissance from international waters. In 1948 the first example with this capability deployed to Alaska and flew missions with the 72nd RS (the 46th's new designation since October 1947) towards the Chukotski Peninsula. Weather impaired operations so the unit, with Presidential approval, assumed a more aggressive stance and overflew Siberia four times between August 5 and September 6 to search for massing Soviet bombers.[17] Not all modifications to the RB-29s came from manufacturers or Wright Field. Based on the success of the prototype B-29 *Ferret*, in August 1947 the 46th RS modified two of its F-13s with SIGINT kit and positions for two operators in the aft pressurised section. In late 1948 Far East Air Forces, desiring a SIGINT capability for the 31st RS as well, modified two squadron RB-29As into SIGINT aircraft at the Japan Air Materiel Area Depot at Tachikawa. Originally built for one operator, they were upgraded the following year with additional SIGINT kit and accommodation for four operators. Not wanting to miss out, European Command activated its own special reconnaissance unit, the 7499th Support Sqn, and flew theatre-modified RB-17s as *Ferrets*.[18] Monitoring the emerging Soviet threat needed a unified effort — and SAC was just the organisation to lead the way in providing it.

NEW SAC, NEW WAR

The Berlin Crisis in 1948 and the growing recognition of the Soviet threat pushed SAC to the forefront of USAF operations. In July 1948 the USAF expanded the 55th Reconnaissance Group (RG) to make it the first of four planned SAC strategic reconnaissance groups. Later that year

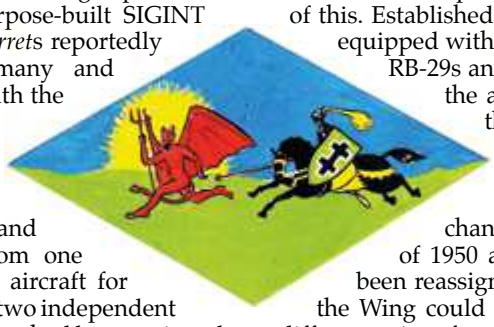
"BY JULY 1948 THE BERLIN BLOCKADE WAS IN EFFECT, AND SAC ESTABLISHED A POLICY OF DEPLOYING FORCES TO THE UK AS A SIGNAL OF TRANSATLANTIC RESOLVE . . ."

TERRY PANOPALIS COLLECTION / BADGE VIA AUTHOR

ABOVE ***Built by Boeing at Renton, B-29A-55 serial 44-61929 was converted to an F-13A and redesignated as an RB-29A in 1948. It is seen here with its name,*** **El Diablo II,** ***painted on the nose.*** **BELOW** ***The badge of the 91st SRS, part of the 91st SRW, depicting a knight on horseback with a Lorraine cross on his shield, chasing the devil.***

the 91st RG underwent a similar transformation and one of its subordinate units, the 324th Strategic Reconnaissance Squadron (SRS), soon took delivery of RB-29AE *Ferrets* to join the prototype B-29 *Ferret*.[19] The 324th SRS started conversion to the North American RB-45C in late 1950, with its RB-29AE *Ferrets* transferring that November to the 343rd SRS of the 55th Strategic Reconnaissance Wing (SRW), being replaced in turn in mid-1951 with purpose-built SIGINT RB-50Gs.[20] The RB-29AE *Ferrets* reportedly flew missions from Germany and Alaska during their time with the 91st and 55th SRWs.

There was considerable activity during 1949–50 as new SAC Reconnaissance Wings were activated and assets were transferred from one unit to another to provide aircraft for training. In November 1949 two independent reconnaissance squadrons that had been assigned to the 311th Air Division, along with two new squadrons and the overseas 31st and 72nd RSs, were assigned to two new SRWs — the 5th and 9th SRWs.[21] The RB-29 fleet was now under one umbrella, with centralised training and tasking.



GROWING WINGS

The process to "grow" a new Wing was rather messy but SAC had few options available to meet the schedule it was on. The pattern would see new aircraft entering the inventory, which would result in the older aircraft, usually RB-29s, cascading down to a newer unit. In some cases, Reconnaissance Wings would receive the bomber version of the aircraft they were scheduled to fly to allow training and type conversion to start. A similar process was used with personnel, where an existing unit would give up a cadre of its most experienced manpower to create a new unit.

The 91st SRW provides an excellent example of this. Established in mid-1948, the Wing was equipped with a heterogeneous mixture of RB-29s and RB-17s. Within 15 months the ageing RB-17s were gone as the Wing began to convert to an all-RB-50 unit. After only one squadron had received RB-50s this plan changed, and before the end of 1950 all of the 91st's RB-50s had been reassigned to the 55th SRW so that the Wing could re-equip with RB-45s. Four different aircraft — meaning four different mission profiles, training programmes and spare-parts stocks — were operated within a span of just 12 months! Even with all these changes, the 91st was nevertheless considered a unit capable of performing operational deployments while undergoing growth and transformation.

The same could be said for two other SRWs in April 1950 — the 5th and 9th. Between the two, there were 14 B-29s and nine RB-29s on strength for "training purposes", and 23 RB-29s for "tactical purposes". Other Wings, such as

AFHRA VIA AUTHOR

ABOVE ***Airmen of the 1st SRS, 9th SRW, pose beside an RB-29 with the tools of their trade in May 1949. The 1st had been activated seven months before with a mix of RB-17s and RB-29s during SAC's initial build-up of forces. In April 1950 the 9th SRW became the 9th Bombardment Wing, the 1st SRS becoming the 1st Bombardment Sqn.***

the 28th SRW, were considered non-operational, and the eight assigned RB-29s were considered training assets as the Wing transitioned to the RB-36.[22] SAC would grow to a total of eight Reconnaissance Wings by 1952, so, as the Cold War became colder, the operational Wings and their "tactical" RB-29s became quite busy.

By July 1948 the Berlin Blockade was in effect, and SAC established a policy of deploying forces to the UK as a signal of transatlantic resolve. While the majority of those forces comprised bombers, the 311th Air Division was required to sustain a presence of at least four reconnaissance aircraft in the UK, with RB-29 units cycling through RAF Sculthorpe in Norfolk.[23]

The first SAC deployment to Europe was with the 16th PRS of the 91st SRW, which sent four RB-29As to Fürstenfeldbruck Air Base (AB) in West Germany in late 1948. The first deployment to the UK was on December 22, 1949, with the arrival of the first of a dozen 23rd SRS RB-29As of the 5th SRW at Sculthorpe. In May 1950 the 72nd SRS of the 5th SRW arrived in the UK, staying until November. By 1951 SAC had started deploying RB-50s, with RB-36s arriving the following year. One exception, though, was the 111th SRW.[24]

The 111th Composite Wing, a Pennsylvania Air National Guard (ANG) unit, was federalised as part of the Korean conflict effort. Its three component bomb squadrons, all ANG units, were also federalised and aligned under SAC as the 111th SRW. The Wing and squadrons moved to Fairchild Air Force Base (AFB) in Washington in April 1951, and the 103rd SRS was issued the RB-29AE *Ferrets* made available by the arrival of RB-50Gs at the 343rd SRS. In August 1952 four RB-29s from the 111th SRW deployed to RAF Lakenheath to replace SAC RB-50Es, flying for three months from the UK. The 111th was disbanded and active-duty personnel arrived to take over the RB-29s under the new designation 99th SRW in January 1953 and start the transition to the RB-36.[25]

A KOREAN INTERLUDE

The outbreak of the Korean conflict in June 1950 forced SAC to conduct a realistic test of its reconnaissance doctrine and capabilities. Although the conflict was not one that SAC relished, it did allow the organisation to test its equipment and tactics in a genuine wartime environment. SAC mobilised the 31st SRS, its only squadron stationed overseas, to provide strategic reconnaissance. Equipped with RB-29s and augmented with detachments of RB-45s and RB-50G SIGINT aircraft, the 31st provided SAC with insights into the potential war it could be fighting with China or the Soviet Union.[26]

After moving from Kadena AB on Okinawa to Yokota AB west of Tokyo, the squadron settled in for the conflict. In July 1950 the unit flew 23 photographic missions, mainly against bridges and airfields, and nine SIGINT missions. The tempo picked up, and by October that year peaked with 81 imagery and eight SIGINT missions. The sortie rate then subsided because

AFHRA VIA AUTHOR x 4

CLOCKWISE FROM TOP LEFT ***A day in the life of a SAC RB-29 unit: Airman Second Class Leon S. Budard, an aerial photographer with the 91st SRS, inspects a K-17 camera before an aerial photographic mission in June 1954. The RB-29 could fly with six cameras — three K-17s, two K-22s and one K-18 — depending on mission requirements. Once the equipment was checked and installed and the briefing completed . . .***

. . . the crew (in this case of the 31st SRS) climb aboard their RB-29 at the start of a mission. The standard crew size of an RB-29 was 12, while RB-29AE SIGINT aircraft could be crewed with up to 14 airmen, reducing the number of gunners and adding up to six electronic warfare officers . . .

. . . on to the target; this photo, taken by a 31st SRS RB-29, depicts military warehouses and barracks at Kanggye in the far north of Korea, which were struck by a force of 22 B-29s of the 19th Bombardment Group on November 5, 1950 . . .

. . . finally, the results of the sortie are assessed by a specialist photo-interpreter, in this case Sgt James E. Kindseth.

AFHRA VIA AUTHOR

A 31st SRS RB-29 undergoes maintenance at Travis. The B-29's Wright engines were a perennial problem throughout its career, and in November 1949 the B-29 force was grounded until aircraft were fitted with modified engines, resulting in a total shutdown of B-29 and RB-29 flight operations that lasted more than two months.

most worthwhile targets in North Korea had been bombed — and since the "threat to mission" had dramatically increased.

The 31st SRS witnessed its first air attack on November 9, 1950, when two MiG-15 jet fighters shot up a squadron RB-29. While gunners claimed the destruction of one of the attacking fighters, the RB-29 was so badly damaged it crashed when attempting to land.[27] After this attack RB-29s were banned from the vicinity of the Yalu River, and recce-tasking in "MiG Alley" was taken up by less vulnerable Lockheed RF-80 jets.[28]

Soon the reconnaissance missions in Korea transitioned to the hours of darkness in order to avoid the increasing threat from communist MiG-15s. All this was nothing new to SAC — the Command understood that daylight strategic reconnaissance missions would face high loss-rates. In November 1950 the squadron was re-designated the 91st SRS at Yokota, freeing up the 31st designator to be transferred home to join the rest of the 5th SRW in converting to RB-36s.

On December 1, 1950, two RB-29s equipped with the 100in focal-length K-30 camera arrived on the ramp of the 91st SRS from the air depot at Oklahoma City.[29] The two RB-29s would be used for "special photographic" missions against Chinese and Soviet targets from international airspace.[30] The production version of the camera tested in Alaska in 1948, the K-30 would also see service in the Berlin Corridor on the modified transports of the 7499th Support Sqn.

By January 1951 the 91st SRS had flown its first operational "special photographic" mission with fighter escort up to the Yalu River to photograph the Chinese MiG-15 airfield at Antung.[31] Additional missions followed, and the squadron would mount "spring campaigns" for "special photographic" missions in 1952 and 1953 as well, taking advantage of optimal weather conditions from March until June. Sorties against Soviet bases in the Kurile Islands north of Japan and the Kamchatka Peninsula confirmed the Soviets were staging Tupolev Tu-4 *Bull* bombers — essentially B-29s reverse-engineered in metric by the Soviets — through these bases to facilitate potential strikes on cities in the USA.[32]

GRADUAL IMPROVEMENT

"Hot war" in north-east Asia notwithstanding, SAC's situation slowly improved over the next 18 months, and by the end of 1952 four Heavy Strategic Reconnaissance Wings were either fully equipped or equipping with RB-36s. Unfortunately for the four Medium Reconnaissance Wings, RB-47 deliveries were running behind schedule. SAC had procured 90 RB-47Bs as an interim reconnaissance platform while awaiting development and delivery of the definitive RB-47E. Although the RB-47Bs had been planned to arrive starting in late 1951, supply problems and production slippages delayed deliveries by more than a year. The RB-47Bs and 88 reconnaissance pods were finally delivered to the 91st and 26th SRWs in the first half of 1953 to replace the interim RB-45s and elderly RB-29s.[33] The 91st SRS, however, continued the fight against communist forces with its rapidly ageing RB-29 fleet. On the night of July 3–4, 1952, the 91st suffered its first loss over Korea with the shooting down by MiG-15s of an RB-29 on a mission over North Korea.

AFHRA VIA AUTHOR

ABOVE ***An RB-29 of the 72nd SRS, 5th SRW, undergoes engine maintenance at Travis AFB, a seemingly endless task associated with the B-29 fleet. When the 5th SRW was transferred from the Second Air Force to the Fifteenth Air Force in April 1950, a new distinctive "Circle X" fin marking was assigned, as seen here on serial 44-61533.***

AFHRA VIA AUTHOR

ABOVE ***Wichita-built RB-29 serial 45-21762 on the ramp at Travis AFB in March 1951. Although wearing the "Circle X" fin marking of the 5th SRW, the aircraft retains its weary Arctic markings with yellow insignia and numbers on the red empennage and wingtips, which dated from the squadron's tenure at Ladd AFB in Alaska back in 1949.***

BELOW ***A whole new dimension — literally. The transition from the RB-29 to the Convair RB-36 was a dramatic step forward in capability for SAC's Heavy Reconnaissance Wings. This April 1951 photo depicts an RB-36 of the 26th SRS, 5th SRW, at Travis with a 5th SRW RB-29 in the background, both adorned with "Circle X" fin markings.*** AFHRA VIA AUTHOR

AFHRA VIA AUTHOR

ABOVE ***The 91st SRS crew of RB-29A serial 44-61948 undergo inspection before they board for another mission from Yokota Air Base in May 1951. The 73 "camera" mission markings on the nose reveal the high tempo of the unit's activities; the 91st was averaging 50 missions per month at the time, with a total of 13 assigned RB-29s.***

After the initial bomber campaign levelled any meaningful strategic targets in North Korea, the 91st SRS was used to monitor the other unacknowledged communist participants of the war — the USSR and China. As well as RB-29 "special photographic" sorties, RB-29 and RB-50G SIGINT missions were flown along the Chinese coast and against the Soviet Union's Pacific mainland as well as the Kurile Islands.

In August 1951 a new mission was passed to the 91st SRS — maritime surveillance. Although lacking the specific training and not equipped with an optimal aircraft, the 91st SRS's RB-29s did possess the long range necessary for this mission type. The squadron was charged with the daily surveillance of the Sea of Japan, searching for Soviet shipping between Pacific Russia and Sakhalin and the Kurile Islands. The mission was seen as vital to monitoring Soviet capabilities and intentions, with the US Navy aiding the effort with an average of two patrol squadrons.[34]

In June 1951 the Post Hostilities Mapping Program in the Far East recommenced, the 91st SRS flying mapping missions over Japan and the south of Korea. Mapping, maritime surveillance and other missions against the Soviets became an increasing share of the sorties flown by the squadron; so much so that by 1952 combat missions over Korea made up less than 50 per cent of its flight activity. These non-combat missions were not without risk, however.

On June 13, 1952, the 91st SRS suffered its first RB-29 operational loss during a maritime mission over the Sea of Japan. The aircraft's shooting down by two Soviet MiG-15s 18 miles (29km) off the Soviet coast, combined with intercepts by unidentified fighter aircraft later in the month, plus the July 3–4 shootdown over North Korea, drove FEAF to switch all maritime missions to night operations starting on July 22 that year.[35] Losses to the Soviets continued with two Lavochkin La-11 piston-engined fighters shooting down another 91st SRS RB-29 on October 7, 1952. The signing of the armistice in July 1953 had little impact on the squadron, its tempo unchanging for another 12 months. Daily maritime surveillance missions and mapping sorties continued, as did "special photographic" and SIGINT missions against the Soviets, the latter aided by an RB-50G detachment. The threat continued; on July 29, 1953, two days after the signing of the armistice, an RB-50G serving in the Far East was shot down.

RETIREMENT AT LAST

By mid-1954 the RB-29 had almost disappeared from the USAF inventory. Of the two Medium Reconnaissance Wings using the RB-29 as a training asset, the 26th SRW had completed

AFHRA VIA AUTHOR

ABOVE ***The smiling crew from the last 91st SRS combat mission flown before the signing of the Korean armistice in July 1953. The war may have been over, but 91st SRS operations continued with little change, as the majority of its missions were already being flown against the Soviets.*** **BELOW** ***The 6091st RS's distinctive badge.*** VIA AUTHOR

conversion to the RB-47 and the 90th SRW commenced receiving its new Boeing jets.

The East Asian communist nations still needed close monitoring, something that was outside the remit of SAC. To provide its leadership with critical intelligence, Far East Command (FECOM) established the 6007th Composite Reconnaissance Group on August 11, 1954. Similar in form and function to Europe's 7499th Support Group, the 6007th oversaw FECOM-assigned reconnaissance squadrons.

On August 9, 1954, the 91st SRS was transferred to FECOM, the unit flying its tired RB-29s for another few months as the transition to the RB-50E took place. The 91st SRS designation stayed with FECOM for another four months, the unit continuing to poke the Soviet Bear with predictable results. The last RB-29 lost to the Soviets occurred on November 7, 1954, when two MiG-15s attacked an RB-29 near the Kuriles; all but one of the crew were recovered from the frigid Sea of Japan.

Six weeks later, on December 20, 1954, the unit was redesignated the 6091st RS and shortly thereafter the last RB-29 mission was flown. Although the RB-29s had outlived their bomber brethren by a month or so, the weather-reconnaissance WB-29 would soldier on for another couple of years. The F-13/RB-29 had a surprisingly long life span in an era that witnessed dramatic changes in technology. Over its ten-year operational career the RB-29 had flown in two "hot" wars and an ongoing cold one, but continued to prove its usefulness up to its very last mission.

BELOW ***The RB-29's successor in SAC's Medium Reconnaissance Wings was the Boeing RB-47. Dedicated photo-recce RB-47Es were operated by the 26th, 55th, 90th and 91st SRWs, while the RB-47H replaced the RB-50G in the SIGINT role with the 343rd SRS. Seen here is RB-47H serial 53-4291; note the SAC "Milky Way" sash on the nose.***

HQS SAC VIA BILL STRANDBERG

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FRANCE'S AIR PIONEERS: JEAN DE CHAPPEDELAINE (AGAIN)

Concluding his series (for now) on "those magnificent Frenchmen" who risked their reputations, fortunes — and often lives — to further the cause of aviation across the Channel, French aviation historian **JEAN-CHRISTOPHE CARBONEL** returns to Jean de Chappedelaine, whose unsuccessful attempts to build a centrifugally-powered flying-car we covered in *TAH33*

IN *TAH33* WE left Count Jean Louis Marie Olivier de Chappedelaine with a working model of his *Gyraptère* flying-car (**RIGHT**) and great ambitions for it — but no sponsor to finance the building of a full-scale vehicle. In June 1931 de Chappedelaine patented a new idea, which incorporated using the "Magnus effect" to slow the fall of a mobile object (i.e. a person or vehicle) and thus achieve a pinpoint landing, and also the use of a powered rotating wing on the lateral axis, which would sustain a vehicle in mid-air.


VIA AUTHOR

THE MAGNUS EFFECT

Dated June 29, 1931, de Chappedelaine's patent describes a "portable glider using rotary wings". The device comprises a light metal or wooden plate fixed to the back of the pilot by means of straps; the plate supports, by means of ball-bearings, a tubular axle, about 1m (3ft 3in) long. To this axle are attached other axles, themselves supporting rectangular panels "the sections of which are in the shape of a low-curvature letter S" and which are free to rotate around the axles.

The inventor explains the principle of his invention, "which is the autorotation of rectangular planes in an airflow. This phenomenon has been tested rigorously and scientifically. It has been observed through precise experiments that a rectangular wing autorotating in an airflow generates a lift equal or superior to twice the lift obtained from a fixed-wing of the same surface, like in a common glider". This principle is known as the Magnus effect and is used in sports like football, tennis and cricket (backspin, topspin etc) to affect the movement of the ball.

An intuitive understanding of the phenomenon comes from Newton's third law, that the deflective force on the body is a reaction to the deflection that the body imposes on the airflow. The body "pushes" the air in one direction, and the air pushes the body in the other direction. In particular, a lifting force is accompanied by a downward deflection of the airflow. If the body rotates in the direction of flight, it will sink faster; if it rotates against the direction of flight, lift is generated.

According to de Chappedelaine, this would enable the construction of "a machine smaller than the usual glider and thus [able to] use wind for gliding or even flights of long duration". There is no evidence that a full-scale machine using such a principle was ever built, although *Histoire Des Hommes Volants* by Jacques Thyraud (Pierre Favre, 1977) illustrates an application of the idea for ski-jumping (see opposite page).

The following month de Chappedelaine filed another patent applying the same concept to an aircraft. Four advantages over fixed-wing machines were listed:

- safety — "this type of aircraft cannot suffer from loss of speed, and in case of in-flight engine failure, the autorotating surfaces considerably slow down and remove any risk from its fall";
- compactness — "the [aircraft's] span can be made quite short, which enables the construction of [a] small and light aircraft";

■ convertibility to a street vehicle — "the rotating wings are easy to dismantle, thus the aircraft can be made to be used on streets";
■ reduction in length of take-off and landings — "take-offs and landings may be made sharply, as with autogyros".

During a visit to the USA later that year de Chappedelaine contacted British pioneer Professor Alexander Klemin, Dean of the Guggenheim School of Aeronautics in New York, and asked him to perform windtunnel tests based on sketches the Frenchman had made. The tests proved inconclusive, however, de Chappendelaine recounting a few years later that the model was "badly mounted" in the tunnel and "vibrated".

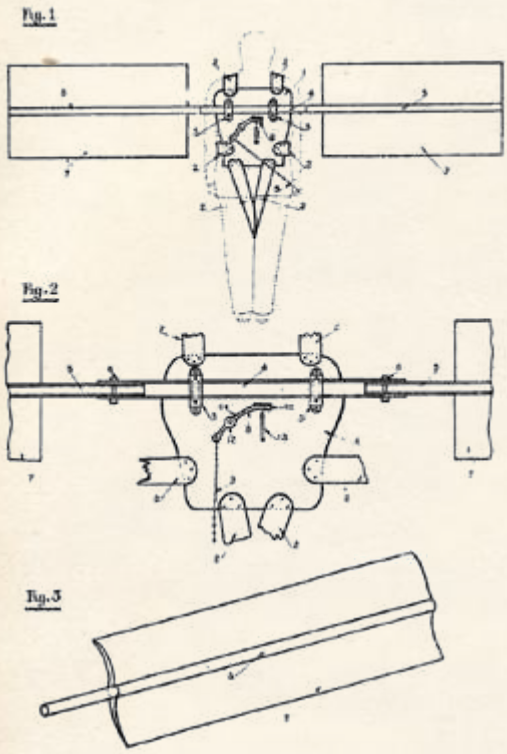
Returning to France in 1933 de Chappedelaine met Georges Desgrandschamps, who had been a bomber pilot during the First World War and had built a small 10 h.p. aircraft for the Grand Prix race organised by *Le Petit Parisien* newspaper in 1923. In 1931 Desgrandschamps had written an instructional book about the "calculus and construction of small aeroplanes". Desgrandschamps and de Chappedelaine incorporated the *Société L'Aérogyre* at No 42 Rue Pasquier in Paris and began to recruit part-time draughtsmen in July 1933.

Meanwhile, in January 1933 de Chappedelaine had put together a proposal regarding how to power the rotating wing in his aircraft, specifying the following objectives:
■ to transform at will the rotating-wing aircraft into a fixed-wing aircraft [either of biplane configuration or, as he envisioned, to integrate the rotary and fixed wings, therefore giving the appearance of a monoplane to the aircraft]. The obvious advantage of such a "conversion" was to improve the drag of the aircraft when the rotary wing was not being used as such;
■ to brake and stop the rotary wing at any angle, thus giving the aircraft the advantage of a variable-incidence wing;
■ to power the rotary wing to a speed beyond the speed of autorotation and therefore increasing its lifting power.

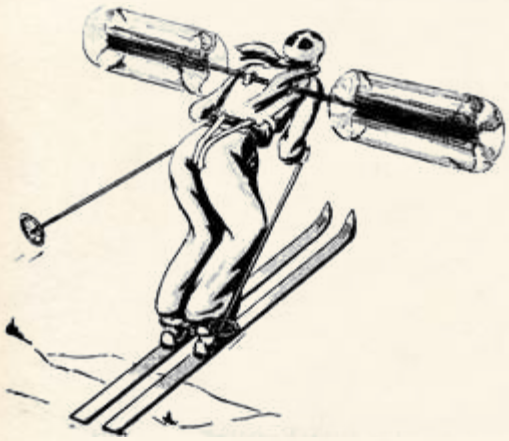
FINANCIAL BACKING

In 1933 de Chappedelaine finally managed to secure financing in order to realise his ideas at full size. The *Service Technique Aéronautique* (STAé — Aeronautical Technical Service, attached to the French War Ministry) awarded him 500,000 francs to build a prototype. This also enabled de Chappedelaine to undertake a new series of tests, first at the Eiffel windtunnel, then at the elliptical windtunnel of the *Service de Recherches Aéronautiques* (Aeronautical Research Service), both in Paris. These showed that the concept was

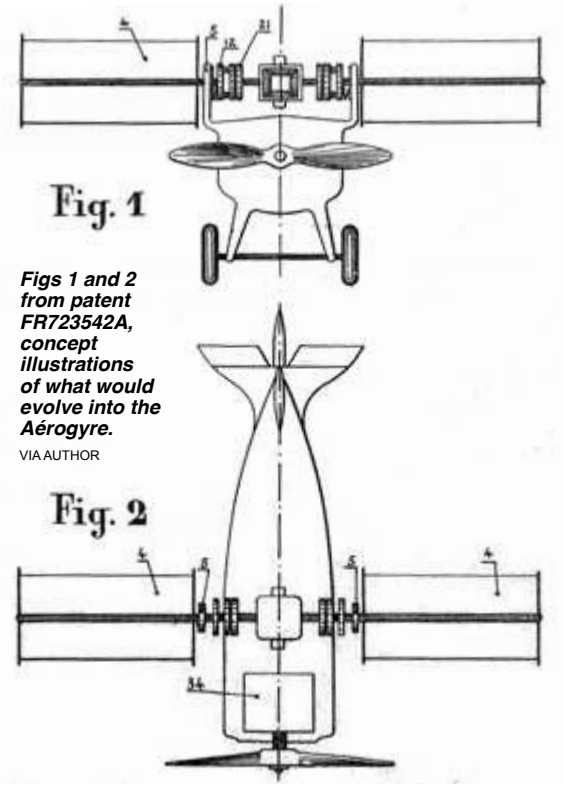
THE 1931 GLIDER PATENT



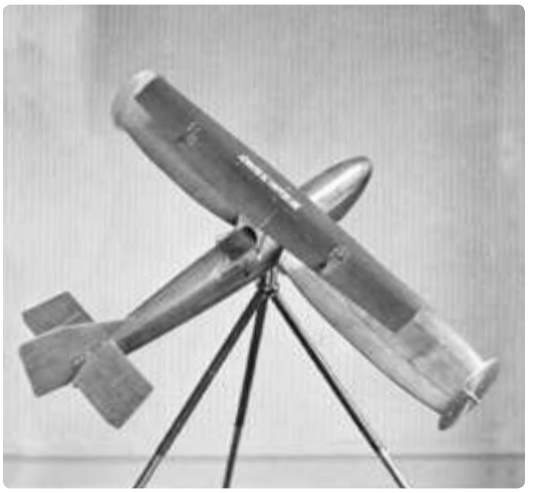
ABOVE ***In June 1931 Jean de Chappedelaine filed French patent FR523527A for a "portable glider using rotary wings", the drawings for which are seen here. Note the low-curvature S-shaped aerofoil profile of the rotary wings in Fig 3.***



ABOVE ***A contemporary illustration of the portable gliding harness used for extending jumps while skiing, as published in Jacques Thyraud's 1977 book*** **Histoire Des Hommes Volants.** ***Where the illustration of this unlikely apparatus appeared originally remains unknown.*** VIA AUTHOR

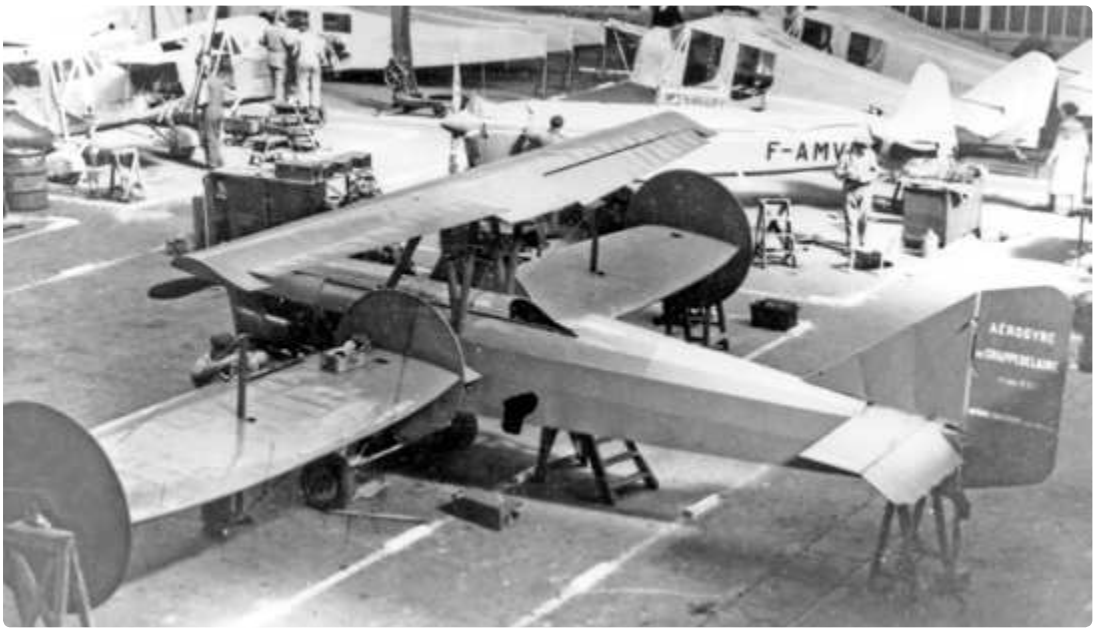


Figs 1 and 2 from patent FR723542A, concept illustrations of what would evolve into the Aérogyre.
VIA AUTHOR



ABOVE RIGHT & RIGHT ***Two images of the Aérogyre scale model tested in the Eiffel windtunnel and others in Paris. Note the discs attached to the rotary wings to stop spanwise lift migration, and the fixed upper wing fitted with ailerons, which was to have been deleted on production aircraft.*** **BELOW** ***Another Aérogyre windtunnel model, this time with a pair of fixed narrow-chord tandem wings mounted above the rotary wings, an idea not adopted for the prototype.***

DE CHAPPEDELAINE FAMILY x 3



DE CHAPPEDELAINE FAMILY

ABOVE ***Bearing the legend "Aérogyre de Chappedelaine, Type CD1" and "Avions Caudron" in smaller letters beneath it on the rudder, the prototype (and sole) Aérogyre, based on a C.270 Luciole biplane, has its final touches added at the very busy Caudron factory at Issy-les-Moulineaux in the south-western suburbs of Paris.***

sound, but that discs at the ends of the rotating wings were needed to avoid spanwise migration of the lift generated by the rotary wings. French magazine *Les Ailes* reported a lift-ratio C_z (normal force coefficient) of 167 without discs, 232·5 with discs and 325 with the rotor-wings driven by an electrical engine. As a result, discs of 1·5m (4ft 11in)-diameter were fitted to the prototype's rotary wings.

Meanwhile, Desgrandschamps gave a lecture entitled *"les voilures nouvelles: aérogyre, formule de sécurité"* ("new wings: the aérogyre, a safety concept") at the first session of the *Etats Généraux de l'Aviation Nouvelle* at the *Aéro Club de France* in the rue Galilée in Paris on May 13, 1933.

THE HARDWARE STAGE

With financing from the STAé and "the enlightening collaboration" of Desgrandschamps, a full-size de Chappedelaine aircraft was built by Etablissements Caudron, based on the latter's Luciole (Firefly) light aircraft but with a reinforced fuselage structure. The aeroplane's standard wings were replaced by two rotary wings, also called rotors, each of 12m² (129ft²) area. The two wings rotated around a Duralumin spar via ballbearings. The spars on either side were linked together by a torque shaft enabling the pilot to operate the two wings synchronously or differentially, the latter to turn the aircraft. The rotary wings were to be locked and used as conventional aerofoils during cruising flight and freed to rotate only during the landing sequence.

The fin-and-rudder assembly was enlarged and a smaller fixed wing of 6m² (65ft²) was attached above the fuselage to include ailerons. According to de Chappedelaine in the April 19, 1934, issue of *Les Ailes*, this was a feature intended only for the prototype: "The definitive Aérogyre will have only rotating wings which can be stopped at will. A differential device will allow the pilot to vary the speed of each wing separately and to stop them at the desired angle".

Finally, the Luciole's standard undercarriage was replaced by a new strengthened undercarriage specially designed by Mercier to accommodate landings with vertical speeds of up to 4–5m/sec (13–16ft/sec). A 100 h.p. Renault 4 Pci four-cylinder inverted inline engine was fitted, with which de Chappedelaine claimed the following performance would be obtained by the new aircraft: a cruise speed of 140km/h (87 m.p.h.); a landing speed of 65km/h (40 m.p.h.) and a take-off roll of 150m (490ft) with the wings in fixed position (roughly equivalent to those of the standard Luciole). With the wings in autorotation mode, the landing speed and take-off roll would be reduced to 35km/h (22 m.p.h.) and 45m (150ft) respectively. With the wings in "activated autorotation" — i.e. induced mechanically (it is not clear if a separate, dedicated engine would be carried for this or if a drive-feed from the Renault engine would be provided) — the landing speed and take-off roll would be 28km/h (17 m.p.h.) and 36m (120ft) respectively. The new machine was summarised by de Chappedelaine thus: "The Aérogyre unites, in a welcome concept, the qualities of the aeroplane and the autogyro, while eliminating the drawbacks of both".

DE CHAPPEDELAINE FAMILY

ABOVE ***The completed Aérogyre at Guyancourt. The first flights of the aircraft were made in September 1934 with the rotary wings locked in conventional aerofoil configuration. It seems likely that the accident that killed Roger Rigaud the following month may have been the result of attempted flight using the rotary wings in autorotation.***

In April 1934 the machine, designated the Chappedelaine-Desgrandchamps No 1 (CD 1), was described as being "nearly complete" after its reassembly at Guyancourt in the south-western suburbs of Paris in preparation for its initial trials but, as happens so often, a first flight was delayed "for budgetary reasons".

TRIALS BEGIN

The machine was examined by the STAé on July 17, 1934, and two days later it was reported that ground trials had begun with pilot Henri Massot at the controls. Two months later, in September 1934, the first flights of the aircraft, albeit with the rotors locked in horizontal aerofoil configuration, were completed. The expected maximum speed of 140km/h (87 m.p.h.) was reached easily. Unfortunately, after only 90min flying time, the aircraft, flown by Massot, was damaged following a sudden drop from 4m (13ft) during a landing. According to a report in *La Nature*, tests with the rotors unlocked had just begun at that time.

Following repairs, the aircraft flew again, flown by test pilot Roger Rigaud. Sadly, on October 10 the aircraft suffered another accident, this time a fatal crash in which Rigaud was killed. The cause of the accident reported in the press was a "partial breaking up" of the airframe during flight. Daily newspaper *L'Intransigeant* was more precise and specified that the cause was the *"hypersustentation"* (lift augmentation) device, which would seem to point to the rotary wings. Had these been in autorotation at the time? It is not known. The machine fell into a garden at Magny-les-Hameaux and was completely destroyed.

After the crash no attempt was made to rebuild the aircraft and de Chappedelaine turned to administrative tasks — although he did not leave the aviation world entirely, as we shall see.

In 1940, as an *Armée de l'Air* officer attached to the STAé, Jean de Chappedelaine was despatched to the USA as part of the French Purchasing Commission to buy war materiel for the French Army. After the fall of France in June that year he elected to remain in America. In 1943, as he later recounted in the August 16, 1947, issue of *Les Ailes* (from which all the following quotes are extracted), he had the idea of applying a boundary layer control (BLC) suction system to rotor blades. As he explained:

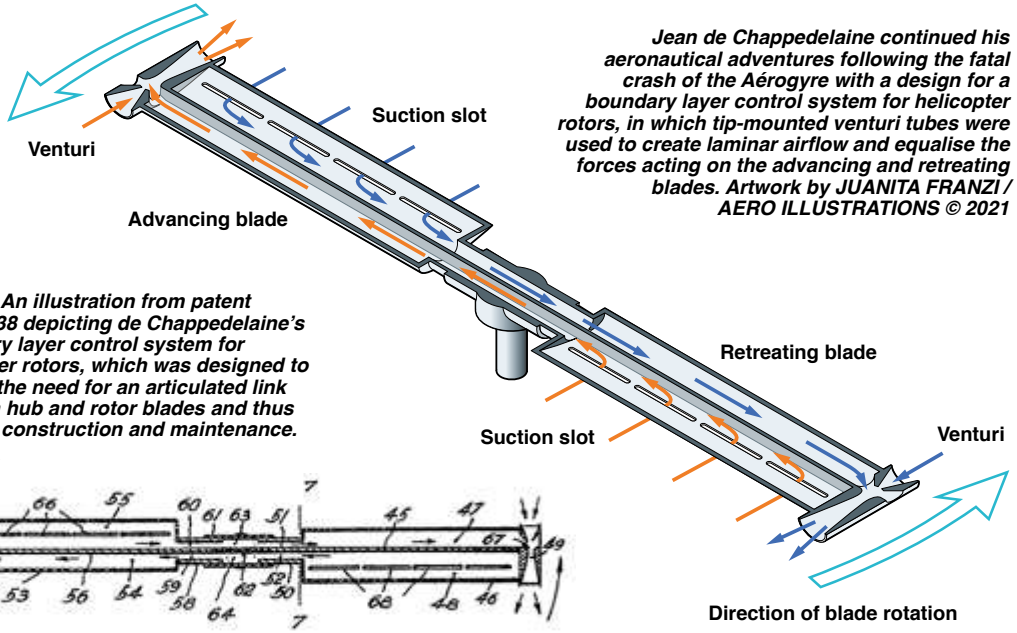
"While improving the aerodynamic performance of the rotor, it also enables the rigid attachment of the blades to the rotor hub. It should therefore be possible to reduce the

CD 1 AÉROGYRE DATA*

Powerplant 1 x 100 h.p. Renault 4 Pci four-cylinder inverted inline piston engine

Dimensions		
Span	9·12m	(29ft 11in)
Length	7·65m	(25ft 1¾in)
Height	3·0m	(9ft 11in)
Wing area		
fixed upper wing	6m²	(64·58ft²)
rotary wing	12m²	(129·2ft²)
Weight		
empty	517kg	(1,140lb)
take-off	680kg	(1,499lb)
Performance		
Maximum speed	140km/h	(87 m.p.h)
Landing speed	40km/h	(25 m.p.h.)

*As reported in the December 1934 edtion of *l'Aéronautique*



Jean de Chappedelaine continued his aeronautical adventures following the fatal crash of the Aérogyre with a design for a boundary layer control system for helicopter rotors, in which tip-mounted venturi tubes were used to create laminar airflow and equalise the forces acting on the advancing and retreating blades. Artwork by JUANITA FRANZI / AERO ILLUSTRATIONS © 2021

BELOW ***An illustration from patent GB576738 depicting de Chappedelaine's boundary layer control system for helicopter rotors, which was designed to obviate the need for an articulated link between hub and rotor blades and thus simplify construction and maintenance.***
VIA AUTHOR

diameter of the rotor disc owing to the increase in lifting power, and to increase the speed with the same power input. Removing the need for an articulated link between the hub and the blade obviously simplifies manufacture.

"The boundary layer suction system should enable automatic compensation for asymmetrical action of air on the rotor blades while they advance or retreat while the helicopter moves forward at speed. The device would also reduce vibration by means of the laminar flow which it generates around the blades."

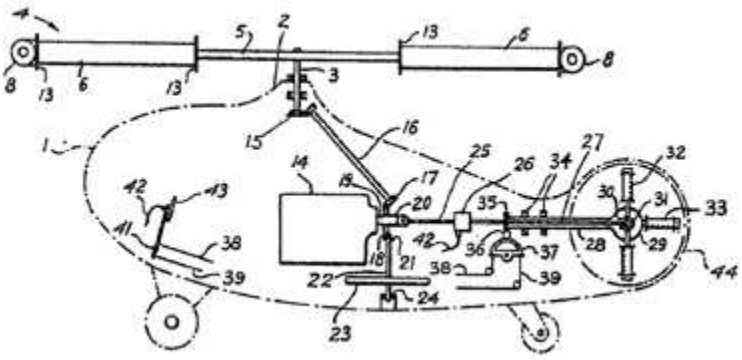
The system was patented in the USA, UK, France, Canada and Brazil. Chappedelaine's system incorporates the placing of venturi tubes at the tip of each blade, ducting air inside the hollow blades and thus generating negative pressure inside each blade. The blades are separated into two compartments, running from the tip to the rotor's axle, which is also hollow. Suction slots are incorporated at about two-thirds of each blade's chord ("very near the trailing edge") along the whole length of each. The venturis are connected to the blades in such a way that they draw air supplied via the slot in the opposite blade; "during horizontal flight, the venturi of the advancing blade therefore produces a lower pressure than the venturi of the retreating blade because its relative speed is higher. The suction is then higher on the retreating blade than on the advancing blade".

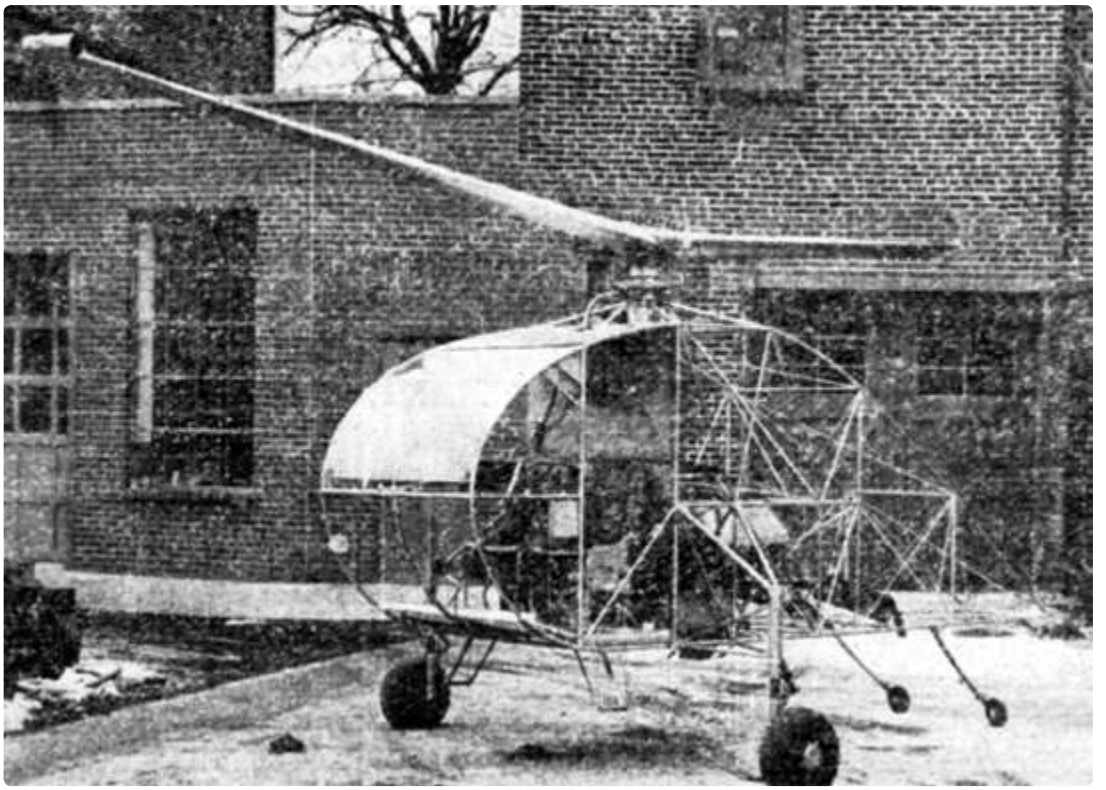
THIRD TIME LUCKY?

With the help of the American Die & Tool Co of Reading, Pennsylvania, a test programme of the system was established. First, a two-bladed rotor of 1·2m (3ft 11¼in)-diameter was bench-tested, the results of which were sufficiently encouraging for de Chappedelaine and his unnamed financial backers — although the article in *Les Ailes* reports that the US Navy was interested in these experiments — to decide to proceed with a full-size helicopter.

The resulting machine was built around a 130 h.p. Franklin engine driving a two-bladed rotor of 9m (29ft 6in)-diameter. However, according to de Chappedelaine, poor assembly of the pinions made only 100 h.p. available to drive the rotor. The fuselage was extremely basic, being essentially just an assembly of aluminium

RIGHT ***Another illustration from patent GB576738 for de Chappedelaine's helicopter design, dated January 6, 1944: "The rotors are driven by an engine* (14) *through shafting* (16, 25), *and a flywheel* (23) *may be provided to act as a stabiliser and also as a temporary source of power in the event of engine failure. A variable-speed gearbox or hydraulic coupling* (26) *may be included in the drive to the tail screws* (32, 33), *which may be tilted about the axis of shaft* (25) *by means of a concentric hollow shaft* (28) *rotatable by a toothed sector* (37).





PHILIPPE RICCO COLLECTION

ABOVE ***Of very poor quality, this is the only known photograph of the full-size de Chappedelaine helicopter. Note the venturi tubes fitted to the rotor tips. The very basic framework was fitted with a windshield and two side-by-side seats, although the numerous tethered take-offs and landings were performed by de Chappedelaine alone.***

tubes. Two seats were installed in a cabin with a rear bulkhead, and a windshield was provided to protect the pilot from the rotor downwash. Controls were limited to a throttle lever and an overhead control column linked directly to the "oscillating plate for the blades' cyclic change of pitch". A special device enabled the column to be locked as a form of limited autopilot. As this experimental prototype was to fly only in tethered mode, no anti-torque device was installed. A steel rope was attached to the tail end of the machine which allowed it to move vertically but not laterally.

The report in *Les Ailes* indicates that de Chappedelaine made a large number of take-offs and landings with the machine thus configured, which demonstrated that the mechanical components worked (with the exception of the gearbox, which proved "difficult" to tame). Unfortunately, the hub disintegrated (an earlier report had blamed the tool company), resulting in the rotor smashing against the walls of the factory. As a result, the project was abandoned, with $75,000 spent on design and testing.

THE FINAL YEARS

In 1948 de Chappedelaine, by this time working for the International Civil Aviation Organization (ICAO), produced a detailed report about the use of helicopters for mail delivery. On February 23, 1950, Jean de Chappedelaine died after a long illness at the home of his mother-in-law, Mrs A.E. Sangster. He had been married to Countess Vera Sangster since 1928. At the time of his death he was an ICAO representative to the United Nations. His joint headstone with his wife is kept in good condition in Pine Hill Cemetery, Cheboygan, Michigan.

HELICOPTER WITH BOUNDARY LAYER CONTROL ROTOR DATA*

Powerplant 1 x 130 h.p. Franklin six-cylinder piston engine

Dimensions		
Rotor-disc diameter	9·0m	(29ft 6in)
Weight		
empty	590kg	(1,300lb)
maximum, fuelled	815kg	(1,797lb)

*As reported in *Les Ailes*, August 16, 1947

ACKNOWLEDGMENTS *The author would like to thank the de Chappedelaine family and Philippe Ricco for their invaluable assistance with obtaining illustrations for this article*

HUNTER 80

Using declassified and previously unpublished official documents, **PETER LEWIS** opens a two-part article on the Swiss Air Force's "Hunter 80" upgrade programme, in which the air arm's venerable Hawker fighters were re-armed and reassigned in 1980 as dedicated ground-attack aircraft, beginning with the introduction of the BL755 "Tabo" cluster bomb

PEERING THROUGH THE canopy of his Hunter after running through his pre-take-off checks, Jean-Luc "Schoscho" Schorer glances over to his wingmen. The elegant 1950s Hawker fighters' Avon engines spool up, and with a single nod from Schoscho and the brakes released, *Albergo* Flight, a four-aircraft formation, power down Raron's Runway 28. Fully loaded with four external fuel tanks, the Hunters clamber into the Valais air and are soon enveloped in low cloud as their heavy climb pushes west down the valley. Escadrille 5's squadron leader and wingmen transit the Alps before arriving just south of Basel some 20min later. With visibility now somewhat better, the four aircraft simulate low-level strafing runs and rocket-projectile (RP) attacks before tightening the formation once again for the transit back south. Back into instrument flight rules (IFR) conditions, the Hunters are just down to minimum fuel levels as they recover into Raron some 75min after departure.

Switzerland's Hunters

For all the assertions that Switzerland operated museum pieces into the 1990s, the Hunter was in fact honed for low-level firepower in the

MAIN PICTURE *In 1994 Hunter J-4040 of Fliegerstaffel 15 was painted in a special "Papyrus" colour scheme, reflecting the unit's "paper aeroplane" badge, to mark the type's retirement from Flugwaffe service. In this stunning photo by the author, J-4040 roars into the Lötschental valley with Sqn Ldr Ueli Leutert at the controls.*

TAH ARCHIVE

ABOVE ***In the summer of 1957 two RAF Hunter F.6s, XE587 and XE588, were sent to Switzerland to participate in comparative evaluation trials for a new Swiss Air Force fighter. One of the two, seen here with a suitably Alpine backdrop at Ambrì, is fitted with outer wing racks carrying Hispano 8cm unguided rocket projectiles for the trials.***

Alps, but was critically short of range if the fight was ever to extend beyond national borders.

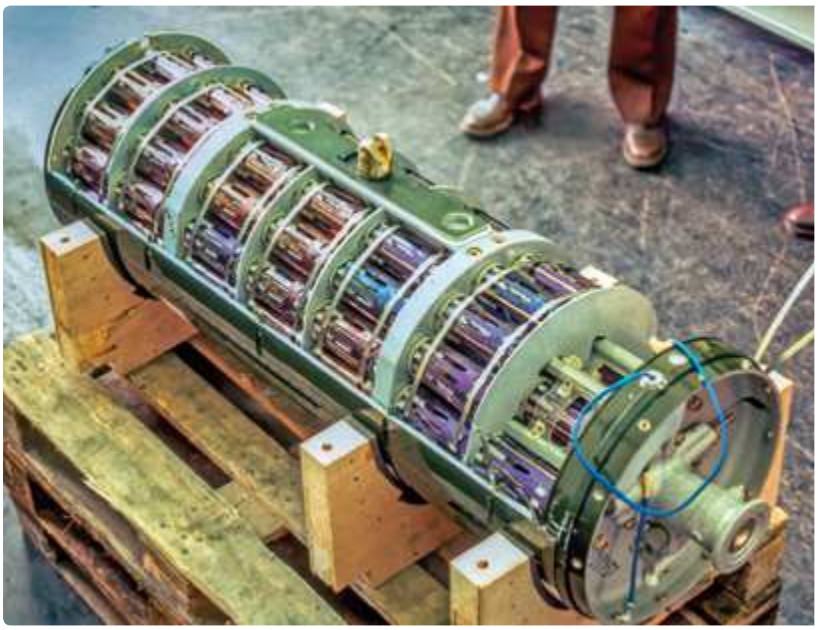
It was Hawker test pilot Bill Bedford who first brought a Hunter to Switzerland, announcing his arrival with a rather poorly aimed sonic bang over Schaffhausen in October 1953, having misjudged the distance to Zürich's Kloten airport. But it wasn't the Hunter's airframe that interested the Swiss at the time; it was the jet engine held within.

Unlike the first two Rolls-Royce Avon-powered examples, the third Hunter prototype, WB202, was fitted with an Armstrong Siddeley Sapphire engine, then seen as being the future standard powerplant for Swiss manufacturer FFA's P-16 jet fighter aircraft. In the spring of 1955 Hans Häfliger, a test pilot from Switzerland's KTA (test flight unit), travelled to Bitteswell in the UK to fly the Hunter. After spending one evening reading the Pilot's Notes, Häfliger flew a Sapphire-engined Hunter F.2 over the Bristol Channel and broke the sound barrier in a dive, becoming the first supersonic Swiss pilot. Three further flights followed including aerobatics, slow manœuvring, handling and mock ground-attacks, to probe the Hunter's flight characteristics. Häfliger's report on the type was extremely favourable, the pilot commenting on the hydraulically assisted flight controls and ease of handling.

Three weeks later, on April 28, 1955, Häfliger was back in Switzerland for the maiden flight of the P-16 at Altenrhein. It was quickly apparent that the P-16 did not possess fighter qualities; its turn-radius at altitude was poor and according to Häfliger, "quite simply, it flew like a truck". Unfortunately the prototype P-16 crashed on August 31, 1955, after a welded joint on a fuel line fractured. Häfliger added to his list of firsts by ejecting from the P-16 before it crashed into Lake Constance just short of Altenrhein.

During 1956 the *Flugwaffe* (Swiss Air Force) retired its last piston-powered North American P-51 Mustangs, and, equipped with de Havilland Vampires and Venoms, became one of the first nations to have an all-jet fighter force. An evaluation process for a new fighter was established, the contenders being the North American F-86 Sabre, Dassault Mystère IV, Hunter Mk 6 and Canadair Sabre Mk 6. Flight tests favoured the Hunter and Canadair Sabre and these two types were pitched against each other again during June–July 1957. The programme investigated the range of both types fully loaded at 30,000ft (9,100m) as well as their bombing and cannon-firing capabilities. The Hunter profited from the Flugwaffe's operational knowledge of the British Venom, and the Sabre was found to be more complicated to service on the ground.

The Swiss Parliament requested that the ruling assembly approve the purchase of 100 Hunter Mk 58s on November 15, 1957, and in January 1958 CHF313m (CHF — Swiss Francs) was cleared to conclude the purchase of 100 airframes, 30 spare Avon engines, 200 external fuel tanks and 30mm cannon ammunition stocks. The Swiss went on to obtain two more batches of Hunters; 30 former RAF Hunters were acquired and refurbished by F+W Emmen in 1970, and, after a Swiss evaluation of the Ling-Temco-Vought A-7 Corsair II ended in political stalemate, a final batch of 30 Hunters was added in 1972; 14 secondhand



SF ARCHIVE x 2

ABOVE LEFT ***A BL755 training round with the outer housings removed, exposing the seven chambers, each of which accommodates 21 stowed bomblets.*** **ABOVE RIGHT** ***Once ejected from the BL755 casing, the bomblet's trigger "feathers", seen here at the top, deploy, fuzing the round. Note the spring and sensor for impact discharge.***

Hunters cost the same as one new A-7. Including eight T.68 two-seaters, the Swiss took delivery of a total of 160 Hunters.

With the introduction of the Northrop F-5 Tiger in the late 1970s *[see the author's* Switzerland's Tiger Force *in* TAH31 *— Ed.],* the Flugwaffe switched the Hunter's role to pure ground-attack. With the final retirement of the Venom in 1983, the now purely militia-manned Hunter squadrons (made up of non-military pilots serving in a part-time, essentially reservist capacity) were at their most numerous and all the mountain bases were still active, before the drawdown that started in the early 1990s. "Ground-attack" for Switzerland meant closing down the lowland diagonal corridor that runs from Lake Constance down to Lake Geneva. Invading land forces would thus have to advance by way of the lowlands and not over or through the mountains, as securing narrow valleys is easy for the defenders. It was the classic Cold War scenario of Warsaw Pact nations sweeping down from West Germany with tanks and armoured personnel carriers (APCs), and with gunship helicopters and ground-attack aircraft providing aerial coverage.

The "Hunter 80 Programm"

At that time the ground-attack Hunters had no modern weaponry with which to undertake their new role, but this was to be addressed with the introduction of two new weapon types; cluster bombs in 1980, followed by air-to-surface missiles (ASMs) two years later, with basic radar-warning avionics and chaff/flare dispensers included as part of the "Hunter 80 Programm".

In 1980 the Swiss Parliament authorised a CHF99m purchase of 4,000 Hunting Engineering BL755-1 cluster bombs, officially designated as the Fl Bb 79 (*Flieger Tiefabwurfbombe* — Aircraft Low Release Bomb), but which the Swiss nicknamed "Tabo". Built to fulfil a UK Ministry of Defence requirement, the BL755 was initially made available for front-line RAF squadrons flying the Harrier, Jaguar and Buccaneer from 1973 onwards.

The 300kg (660lb) bomb comprised a frangible housing holding seven compartments containing a total of 147 individual bomblets. A small arming-vane turbine mounted in the bomb's nose wound down a pre-set time and actuated the device. After release, the casing opened and emptied during the free-fall phase, the 147 charges forming a small lethal cloud using the shotgun principle of scattering and increasing the kill-probability radius. Each bomblet created 2,200 pieces of shrapnel, lethal to anyone close enough to trigger the unit's splayed "feathers".

The principal targets for the BL755 were light armoured vehicles and troops. With the introduction of the Tabo, Switzerland planned on retiring its use of the 400kg (880lb) napalm bomb *(Feuerbombe FBb),* which had principally been Venom-specific ordnance. Although there was a concern that very low releases may jeopardise the Hunter itself, this risk was assessed at the Segnas Pass in central eastern Switzerland and proved unfounded; the bomblets only detonated on ground impact, fracturing and sending shrapnel in all directions, by which time the aircraft was several hundred metres away. The

SF ARCHIVE x 2

ABOVE ***With Dayglo orange sections applied to the standard Flugwaffe Hunter camouflage scheme, J-4013 performs a test drop of a BL755 "Tabo". The 147 individual bomblets are seen here being ejected from the main assembly. The Hunter is also carrying Swiss Oerlikon 8cm unguided rocket projectiles and a Carrier Bomb Light Stores (CBLS) mounting.***

RIGHT ***A BL755 "Tabo" test round installed on the starboard outer wing pylon of GRD's evaluation Hunter J-4013. The BL755 was produced by British firm Hunting and was introduced into service with the RAF in 1973, being fitted to the Harrier GR.3, Jaguar and Buccaneer. It was deployed by the RAF during the Falklands conflict and the Second Gulf War.***

test at Segnas, using two bombs, gave a spread area of approximately 40m x 160m (130ft x 525ft), the rule of thumb being that one bomb would "neutralise" an area the size of a football pitch.

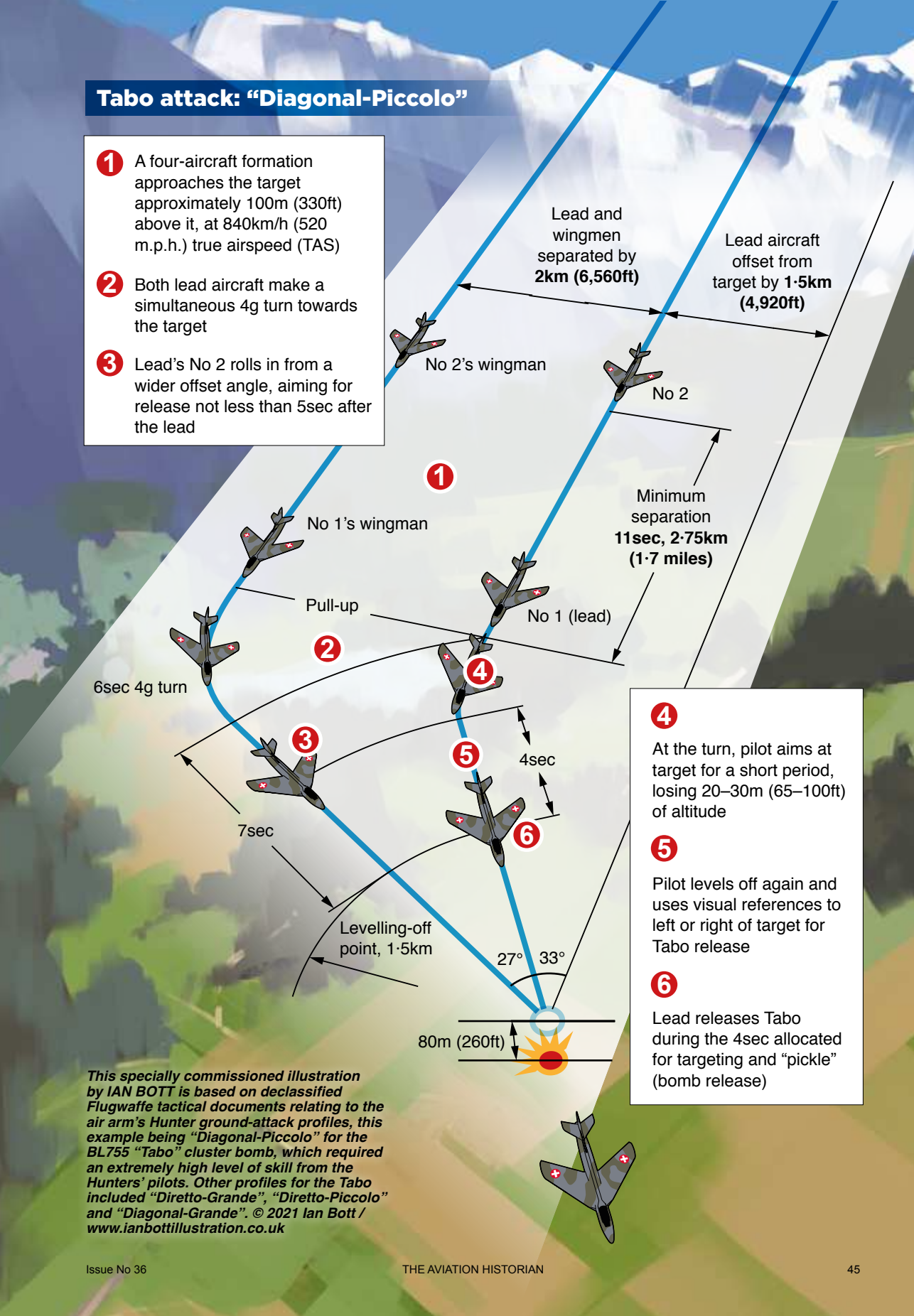
Apart from this test and three other known flights flown by orange-liveried Hunter J-4013 by the *Gruppe für Rüstungsdienste* (GRD — Armaments Services Group), Swiss Hunters never carried "live" bombs, although beige training bombs were used in order to familiarise groundcrews and pilots with their procedures and drag characteristics. During the Segnas test, Swiss Army professionals from Thun took the opportunity to create a method for clearing the area of bomblets; creating an effective minefield is one thing, but with rapidly changing territorial gains an area controlled by the enemy one day could be friendly territory the next.

Tabo attack profiles

The Hunter's normal BL755 configuration would have been one on each of the aircraft's outer wing pylons, as the inner pylons were occupied by an external fuel tank. Wartime plans, however, specified four bombs per aircraft, including the two-seaters. The delivery profile for the BL755 necessitated a much flatter target-approach than a regular attack or toss-bombing attitude. Dropping a cluster bomb from a steeper dive angle sends the whole package into a fairly small and concentrated area; flying a flatter approach guarantees a greater bomblet distribution and a less dense spread. The bomblets required about 2–2½sec to arm after being dropped; if the drop time was too short, they would fall to the ground inert. This flatter and carefully timed delivery required a far greater degree of height- and target-awareness from the pilot than that used for standard "iron" bombs.

The most commonly practised Tabo attack profile was the "Diagonal–Piccolo" (see opposite page). Flying in a four-aircraft formation with the two lead aircraft line-abreast at a distance of 2km (1¼ miles) and the leader offset from the target by 1·5km (0·9 miles), the formation approached the target approximately 100m (330ft) above the latter's own height, with the speed set at 840km/h (520 m.p.h.) true airspeed (TAS). Both Hunters would then simultaneously make a 4g turn towards their target, the lead releasing his bombs — ideally pulling around 0·9g during the light parabolic flight phase — during the 4sec allocated for targeting and "pickle" (bomb release), with No 2 rolling in from a wider offset angle and aiming for his release no less than 5sec after the lead, in order to prevent the second Hunter flying

Tabo attack: “Diagonal-Piccolo”



This specially commissioned illustration by IAN BOTT is based on declassified Flugwaffe tactical documents relating to the air arm’s Hunter ground-attack profiles, this example being “Diagonal-Piccolo” for the BL755 “Tabo” cluster bomb, which required an extremely high level of skill from the Hunters’ pilots. Other profiles for the Tabo included “Diretto-Grande”, “Diretto-Piccolo” and “Diagonal-Grande”. © 2021 Ian Bott / www.ianbottillustration.co.uk

ABOVE ***Hunter J-4103 of Fliegerstaffel 20, based at Mollis in eastern Switzerland, is towed out for a training sortie fitted with CBLS pods with 4kg practice bombs installed to simulate BL755 attack profiles. A total of 14 Flugwaffe units, plus the*** **Patrouille de Suisse** ***formation aerobatic team, operated the Hunter during its 35-year Swiss career.***

PETER LEWIS x 2

ABOVE ***Whistling in over the "piano keys" on Runway 32 at St Stephan in south-western Switzerland, J-4091 of Fliegerstaffel 15 returns with empty CBLS pods, having flown a practice sortie over the mountain range at Axalp in the Bernese Oberland. This aircraft later went to the USA as N58MX, but sadly was lost in a fatal crash in 2006.***

PETER LEWIS

ABOVE ***Lined up on the Axalp target range during a simulated cluster-bomb target practice sortie, J-4095 drops two 4kg Dayglo training bombs from its outer wing-mounted CBLS pods. Swiss Hunters almost always flew with external fuel tanks owing to the high fuel consumption of the ageing fighter's Rolls-Royce Avon turbojet engine.***

into the leader's bomb blast. Hunters Nos 3 and 4 would then replicate the approaches of the initial two aircraft. Minimums for release were given as 70m (230ft) above target and from 50m (165ft) horizontal distance.

To learn to fly the flatter cluster-bomb delivery profiles, the Swiss used a 4kg (8·8lb) practice bomb, the U Bb 81 (*Übungsbombe 81*), two of which were carried in Carrier Bomb Light Stores (CBLSs) — or in Swiss parlance *Übungsbombenreck 78s* — purchased from the UK. The front section of the training round was of basic steel construction with a hardened-plastic rear section making up the tail and fins, coloured orange so the used rounds could easily be found and cleared away from the ranges. A slot at the base of the fins allowed groundcrews to mount a marking charge so that when the round impacted the target a flash was generated to assist the range controller judging the drop accuracy. The Swiss called this the "Mark Pat" for *Mark Patronne* (ownership mark), but its use was very rare.

More Tabo tests

Further BL755 tests were performed over Lake Neuchâtel in early May 1987 by the Flugwaffe's Brigade 31 DEK (Ground Attack Command), assisted by GRD, to try to expand the air arm's delivery profile of the munition to accommodate higher speeds up to 960km/h (600 m.p.h.). Inert BL755s were dropped in conjunction with the 4kg practice bombs by two Hunters from Payerne.

The BL755 Tabo was a lethal and fearsome weapon. But it also posed a significant risk to the Hunter pilots tasked with delivering it. By definition, the cluster bomb has to be deployed close to its intended target for the maximum field of coverage to be realised. Recognising the hazard posed to the attacking Hunter, GRD contacted Hunting in the UK in 1986 to obtain a quote for an adapted BL755 that could be used for toss-bombing after an initial domestic feasibility study was launched in 1984. The comparison test looked at the Hunter and, interestingly, the General Dynamics F-16, which many contemporary internal documents suggest was to be Switzerland's new fighter for the 1990s.

Flights with the Hunter in 1985 were monitored by the Skyguard area-defence system. Combining test data from Hunting and from its own tests, GRD calculated that release distances from 5km (3 miles) with bomb-release at 4km (2½ miles) were possible with a 3g loading and a specific attacking-climb profile with an approach speed of 900–960km/h (560–600 m.p.h.). It was clear that the falling bomblets' increased kinetic energy would make them penetrate deeper when released higher and at a greater angle, but that the accuracy and spread-density of the bomblets would decrease. The individual bombs would also need to be adapted to add an additional timer setting to the existing four available.

Although Hunting offered an improved BL755 with parachute-drogue-equipped bomblets to improve the lethality of the weapon, the dropped inert-round percentages increased as well, but Switzerland never requested pricing for this conversion. Brigade 31 commented on Hunting's

PETER LEWIS

ABOVE ***Eight Hunter T.68 two-seaters were supplied to the Flugwaffe during 1974–75; they would have been called into the fight had the Cold War warmed up. Fitted with two cannon, the T.68 could also drop ordnance, fire rocket projectiles and carry a single AIM-9 on the port outer pylon, but it was never configured for the Maverick.***

initial offer in early 1987 that toss-bombing with the BL755 could work well against targets that would have been impossible to fly over, as they were deemed too risky for the Hunter to attack — anti-aircraft batteries for example. Precision attacks against tanks was not the aim for toss-bombing with the cluster bomb; these were better performed with the low-flying approach. No further action was taken, squadron pilots never practised toss-bombing techniques and the BL755s were never modified. Interestingly, Switzerland also concurrently evaluated the American GBU-12 Paveway II laser-guided general-purpose bomb in May 1986 with a good success rate, but determined that the challenge of training and enabling air-borne targeting illumination was beyond the Flugwaffe's level of electronic warfare competence.

From 1991 to 1993 full-time *Überwachungs-geschwader* (UeG — Surveillance Wing) pilots from Squadron 1, backed by militia pilots from Squadron 8, flying the F-5, flew with BL755 and CBLS training rounds to check the Tiger's ground-attack handling qualities. It turned out that the F-5 was not an ideal mount for the role. When the Hunter was withdrawn from Flugwaffe service in 1994, stocks of BL755s were kept stored until the first McDonnell Douglas F/A-18 Hornets arrived; but by then, future ground-attack doctrine had long been shelved. In 2013, in accordance with the 2008 international Declaration on Cluster Munitions, Switzerland confirmed that along with certain other artillery munitions, all of its remaining 3,999 BL755-1s had

PETER LEWIS

ABOVE ***In 1982 Switzerland ordered the Hughes AGM-65B Maverick air-to-surface missile as part of the Hunter upgrade programme. With callsign "Behaki", J-4099 of Fliegerstaffel 15 is seen here on Runway 14 at St Stephan in 1993 with an AGM-65B training round on its port outer wing pylon; a 200kg inert bomb was used as a counterweight on the starboard outer pylon.***

been dismantled and destroyed during 1997–2000.

During the Yom Kippur Arab-Israeli conflict in October 1973, the Israeli Air Force fired 50 US-built AGM-65A Maverick air-to-surface missiles (ASMs) at Arab targets including tanks, command bunkers, surface-to-air missile (SAM) sites and bridges, of which 47 were considered to be direct hits. The desert environment conditions (clear optical backgrounds) clearly favoured the missile, but a success rate of over 90 per cent was remarkable and unmatched by any other ASM system of that generation. By the 1980s there were more than 10,000 Mavericks stored in Europe, specifically to address the overwhelming numerical supremacy of tanks possessed by the Soviet Union and Warsaw Pact forces.

Enter the Maverick

Switzerland was well aware of the weapons systems that the Hunters would potentially face when it came to selecting new armaments. Studies by GRD against simulated Soviet ZSU-23/4 *Shilka* self-propelled radar-guided anti-aircraft units revealed a seven per cent attrition rate for the Hunter when it attacked with just its four 30mm cannon, and a much lower 1·3 per cent loss-rate with a Maverick. Extrapolating results from those studies and applying them to the Soviet SA-8 *Gecko* SAM and the cannon-only-equipped Hunter, the latter's loss-rate was 29 per cent, and higher with the Maverick at 36 per cent. The higher loss-rate with the Maverick was because the Hunter had to be within line-of-sight to acquire the *Gecko*, whereas a pop-up cannon-attack allowed the Hunter pilot to use topographical cover until the very last second, at which point he would be too close for the SA-8 to acquire him as a target and fire.

Further calculations judged the Maverick to offer significant improvement over "dumb-bomb" deployment, as pinpoint attacks would negate the need for repeatedly attacking the same target to ensure destruction. Warsaw Pact forces were estimated to have more than 250 *Shilka* vehicles and a dozen SA-8 *Gecko* units, along with hundreds of SA-7 *Grail* man-portable air-defence (MANPADS) weapons during the early 1980s.

Representatives of GRD, the Flugwaffe and the *Bundesamt für Militärflugplätze* (BAMF — Federal Department for Military Airfields) were in close contact with their peers in West Germany, most notably in Koblenz at the *Bundesamt für Wehrtechnik und Beschaffung* (BWB — Federal Office for Defence Technology & Procurement) and the Luftwaffe's technical division at Kaufbeuren to compare notes on the Maverick. Andrea Lareida was BAMF's representative and avionics expert and he recalled many visits to both West Germany and the USA to collect essential Maverick data which was presented to parliament for approval, and then ensure that the missile and its ground support were in good hands in Switzerland. When Switzerland ordered the AGM-65B Maverick from Hughes, it was the most technically complicated weapons system ever to have equipped the Hunter.

NEXT TIME *The author concludes his in-depth look at Switzerland's "Hunter 80" upgrade programme with the Flugwaffe's adoption of the Maverick for its ageing Hunter force, up until the type's retirement in late 1994*

A MISSED OPPORTUNITY?

The tantalising possibility of a truly long-range PR Spitfire

Hindsight is a wonderful thing — even for legendary test pilot Jeffrey Quill, who more than 20 years after the end of the Second World War pondered a potential missed opportunity to create a truly long-range photo-reconnaissance Spitfire. In his final article, the late **MELVYN HISCOCK** recalls a chain of conversations regarding an intriguing "what if . . ?"

THIS ARTICLE WAS prompted by a conversation many years ago in the office of renowned Hampshire-based aircraft restorer Vivian Bellamy (1919–98); it came back to mind following a recent online discussion on the excellent Britmodeller forum. The story begins with Supermarine Spitfire two-seat trainers.

A Spitfire for two

As is well known, the Spitfire Trainer was prototyped on MT818, a standard Mark VIII converted in 1946. No orders for the Tr.8 trainer were forthcoming but Vickers-Armstrongs did convert a total of 20 Tr.9s for the Netherlands, India, Egypt and Eire. The company also did some preliminary design work on a trainer version of the Mark XVIII.

Flown as a demonstrator, Tr.8 MT818 was by 1952 in storage at Chilbolton. It remained there until it was acquired by Viv Bellamy for the Hampshire Aeroplane Club at Eastleigh, with which it flew as G-AIDN. There it was flown by club members until bought by Viv's brother-in-law, John Fairey, the second son of pioneering British aircraft manufacturer Sir Richard Fairey.

Late in life, Viv had an office at Longparish, near Andover, and I used to pop in from time to time to see him. One afternoon we got on to the topic of Spitfires, and the subject of Supermarine test pilot Jeffrey Quill came up. Needless to say, Viv had known him; and he told me about a

ABOVE ***What might have been? This artist's impression by MARK HARRIS shows what a Griffon-powered "Spitfire PR.XVIII" — adapted for extended range with the cockpit relocated rearwards to accommodate more fuel and cameras — may have looked like. Artwork © 2021. For more info on the artist's work visit www.markharris.ca.***

TAH ARCHIVE x 2

ABOVE ***The prototype Tr.8 two-seat trainer, MT818, seen here wearing its B-Conditions marking N32. It was later put on the British civil register as G-AIDN and survives today with the Biggin Hill Heritage Hangar.*** **LEFT** ***The irrepressible Vivian Bellamy (left) and actor James Fox during the making of the uncompleted film*** **Biggles Sweeps the Skies** ***in 1969.***

wartime incident that had happened at High Post. Some Americans had come in to collect Spitfires and, when they took off, they kept the Spitfires on the ground a while longer than normal and then retracted the mainwheels while the Spits were still very close to the deck, so that they appeared to pop up only just as they took off. Several spectators had been impressed, and Quill noticed this.

He was due to fly a Spitfire soon afterwards, and he climbed in and started up in the usual way. He then began his take-off roll and, the moment the tail came up, one wheel popped up into the wheel-well. As he lifted off, the other did the same. In order to do this he must have selected wheels-up as soon as the tail was up, and kept just enough side load on the remaining wheel to prevent it retracting until flying speed was reached. It could have all ended with a Spitfire on its belly shedding prop blades, but

"We were stupid, you know; this would have been the answer to the range problems of the photo-reconnaissance Spitfires…" – Jeffrey Quill

TAH ARCHIVE

ABOVE ***Former Irish Air Corps Tr.9 G-AVAV was one of the two-seaters used for the filming of*** **Battle of Britain.** ***Flying a two-seat Spitfire from the rear seat was not ideal in terms of the pilot's field of view, but certainly possible in the hands of an experienced pilot. This aircraft also still survives today with the Biggin Hill Heritage Hangar.***

Quill was a good enough pilot that it did not.

Viv mentioned that Quill had been a consultant on the 1969 *Battle of Britain* film. Viv had been one of the film pilots and, during the shoot, had managed to fly one of every aircraft type in the film except the Junkers Ju 52/3m. He went on to tell me about a conversation he had had with Quill. Several of the Spitfire pilots had flown one of the Tr.9s with a Cineflex camera in the front seat and the pilot in the rear. Viv told me that Quill had asked him how difficult that was, and if he thought a reasonable squadron pilot could have managed to fly from the rear seat. Viv replied that visibility was not good — but it was hardly good from the normal position and so, in his opinion, a reasonably competent pilot would have no problems; he had certainly had none. At that point, according to Viv, Quill said something along the lines of "We were stupid, you know; this would have been the answer to the range problems of the photo-reconnaissance [PR] Spitfires".

Never originally designed with range in mind, the Spitfire was conceived as a point interceptor, intended to get up to height quickly, attack an unescorted incoming bomber stream and then return and refuel. The original variants had just 85 Imp gal (386lit) of fuel.

Throughout the war various methods were tried to shoehorn more fuel into the Spitfire. Fuel tanks were fitted into the leading edges and into other spaces within the wings, and during its life as a single-seater MT818 had been test-fitted with a 75gal (341lit) tank behind the cockpit. This obviously had a detrimental effect on the handling of the aeroplane — it was already quite unstable in pitch. A test on (coincidentally another survivor) RR232, in June 1945, stated that with 25gal (114lit) in a rear tank it was just acceptable for combat. Some Spitfires were built with a 29gal (132lit) tank in the rear fuselage but even then the pilot was advised to use all fuel from this before using the main or wing tanks.

An idea worth investigating?

Jeffrey Quill's comment — that a solution may have been to move the cockpit back — is worth investigating, although it is not entirely straightforward. By moving the cockpit back, the usable payload is positioned much closer to the centre of gravity (c.g.) and so has far less influence on the handing of the aeroplane as fuel is used up.

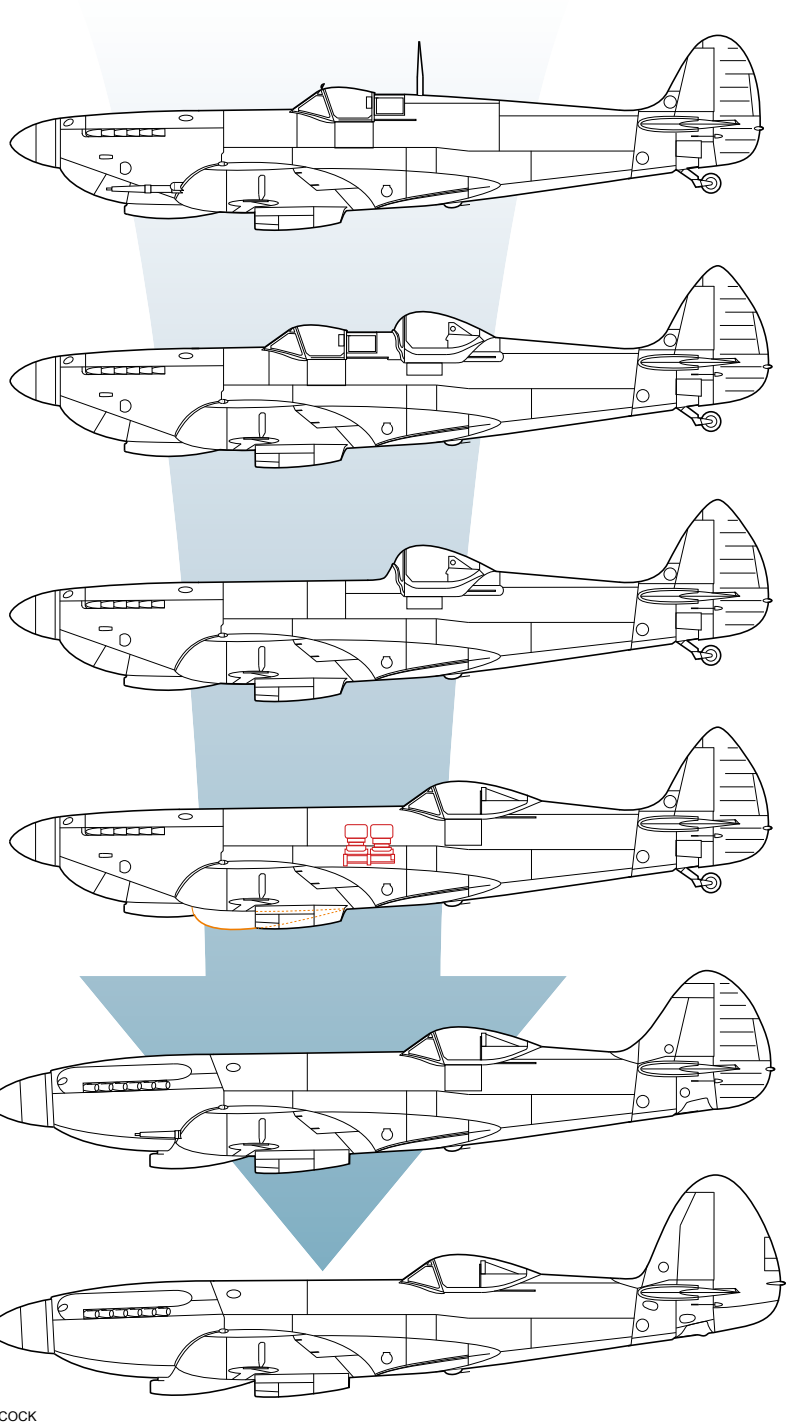
To convert a Spitfire to a Tr.9, the original cockpit was moved forward 13½in (34cm) to make room for the second cockpit behind; the front of the latter was where the seat would have been mounted on the single-seater, roughly in line with the wing trailing edge. This, of course, meant the rear cockpit was moved backwards and, with the tail down, effectively lower than the leading edge of the wing; therefore the rear cockpit was raised slightly to improve vision, and a new bubble canopy fitted.

Even a cursory glance at a Spitfire side elevation shows that deleting the trainer-configuration forward cockpit could allow a doubling of the size of the standard fuel tanks, and probably still leave room for PR cameras on the centreline of the aeroplane. That would give 170gal (773lit) of fuel in place of the standard 85gal, and, added to the "wet wing" of later PR Spitfires, would have offered a really significant increase in range.

REARWARD-COCKPIT SPITFIRES

The evolution of a speculative idea . . .

These artworks are based on preliminary sketches prepared by the author during the final weeks of his life



1 ***Standard fighter Spitfire F Mk IX***

2 ***Standard trainer Tr.9*** in which original forward cockpit was moved forward 13½in (34cm)

3 ***Rearward-cockpit Mk IX with Tr.9 rear cockpit only*** looks "ridiculous, a little like a pimple"

4 ***Rearward-cockpit Mk IX with teardrop canopy*** with cockpit moved a few inches further aft to accommodate cameras aft of slipper tank

5 ***Rearward-cockpit Mk XVIII*** showing how a Griffon-engined variant might look

6 ***Rearward-cockpit Mk XIX*** with larger Mk 24-style fin & rudder

TAH ARCHIVE

ABOVE ***The Spitfire Mk XVI was originally essentially a Mk IX with an American-built Packard Merlin 266 engine, but later production Mk XVIs incorporated a "low-back" aft fuselage with a teardrop canopy and the broader-chord rudder fitted to later production Mk IXs, all modifications which are visible on this Central Gunnery School Mk XVI.***

The spine of the fuselage in front of the remaining cockpit would be lower, and playing around with some drawings suggests that using a standard teardrop canopy would give a very similar rear fuselage shape to the low-back Spitfires — whereas using just the existing rear canopy of the two-seater would look ridiculous, a little like a pimple. The teardrop canopy would, however, lower the cockpit further into the fuselage, making forward vision an extra bit more difficult; but I can think of several aircraft, from the Gee Bee to some Caudron racers, where it was, if anything, worse.

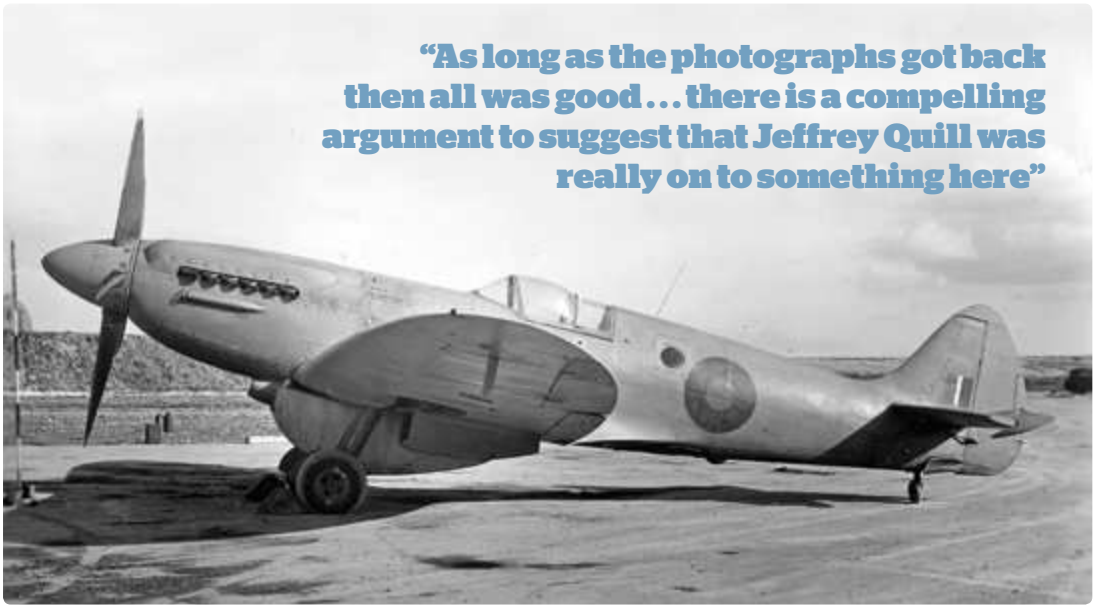
These modifications would result in a loss of fuselage side area, which I will come to in a moment; and would necessitate moving the vertical cameras from behind the seat to a position in front of it. Unfortunately much of the fuel capacity on, for example, a standard Spitfire PR.XI, would be from the use of underfuselage slipper tanks, a common sight on Spitfires, but these are sadly not transparent and so would block the cameras. However, there are examples of Spitfires being fitted with slipper tanks that had F24 cameras actually mounted within. A downside to this was that the slipper tank was designed to be slipped, should the Spitfire come under attack. Since the principal reason for the flight would be to obtain photographs, lobbing them into some poor unfortunate's farm in Europe would defeat the object of the sortie.

Stability issues?

There is, though, an alternative approach to this. Early PR conversions of Mk I Spitfires, for example the Spitfire C, had a blister under the port wing containing two F24 cameras. Lens focal length may not have been as long as could be fitted into the fuselage, but I have no doubt that this would be a problem sorted by improved

The Griffon-powered Spitfire Mk XVIII was built in two variants, the F.XVIII as a fighter-bomber and the FR.XVIII, as seen here, as a fighter-reconnaissance variant (note the camera aperture aft of the cockpit). The Mk XVIII had a "low-back" fuselage and teardrop canopy and a further enlarged rudder.

TAH ARCHIVE



TAH ARCHIVE

ABOVE ***Seen here with a 170gal slipper tank on its centreline, the Griffon-powered Spitfire PR.XIX was the last of the type's dedicated photo-reconnaissance variants and incorporated a "high-back" fuselage. The most suitable candidate for a potential specialised PR Spitfire variant with a rearward-located cockpit was probably the FR.XVIII.***

optics. Need will always spur innovation.

The loss of fuselage side area may well have affected directional stability, but to what extent? I asked display pilot Air Marshal Cliff Spink, who has flown all marks of Spitfire currently airworthy, if there was a noticeable difference in flying a low- or high-back Mk IX/XVI. He told me that in his view there was little if any difference — but this could be because he was flying both variants regularly, and so handled small variations unconsciously. However, he did feel there was a noticeable difference between the low- and high-back Griffon-powered Mk XIV, with the low-back being slightly more "squirrelly" but perfectly manageable. I asked if the slightly larger tail fitted to the otherwise similar Mk XVIII made a difference and he was adamant it did, to the point that it transformed it handling-wise into "a pussycat". When you consider some aficionados are not even aware the later model even has a larger tail, its effect for its size is significant. Since the tail of a Spitfire is simply a bolt-on unit, if there was a problem of directional stability it would be relatively simple to install the larger tail of a Mk XIV/XVIII.

The thought of Vickers-Armstrongs working on a "Tr.18" would make a rearward-cockpit Mk XIX a possibility too. If there were directional stability problems then a Mk 22/24 fin could be used, but this is all hypothetical. Mocking this up in drawing form, however, produces a very interesting aeroplane (see page 53).

It is in landing that the problems lie. Viv Bellamy certainly told me that he had no problems during his film work, and he was not the only pilot to fly from the rear, albeit from the standard Tr.9 cockpit rather than a modified Mk XVI (hence perhaps a few inches higher). Since it had been more than 20 years since my conversation with Viv and he sadly left us many years ago, I spoke to current Rolls-Royce Director of Flight Operations and test pilot Phill O'Dell, who has experience in the Rolls-Royce Griffon-engined Mk XIX as well as considerable experience in the Mk IX and Tr.9 from the front cockpit when flying for the Boultbee Academy and from the rear seat when instructing.

Over a convivial gin and tonic following a Jersey Air Show a few years ago, I asked Phill if he thought Viv had been correct about ease of landing. Phill said he was fairly convinced that there would be, at least, a significant increase in workload. However, in conversation more recently, he told me "To be honest, I've had a rethink and it deserves more thought. I forget that we really treat these aeroplanes with 'kid gloves' nowadays and fly them well within the parameters used during the war. In wartime the pilots were much more current and used to operating at the limits. They would be very used to three-point landings, wheelers and 'tail-down wheelers', and the odd landing mishap was taken as acceptable as there was enough infrastructure to repair the aircraft. As long as the photographs got back then all was good. Thinking about this again, there is a compelling argument to suggest that Jeffrey Quill was really on to something here".

Of course, it didn't happen; and, apart from some Soviet in-field conversions, no Spitfires had a cockpit pushed back until 1946. But it does make an interesting "what if . . ?"

THE GOLDEN AGE?

With their luxurious promenade decks, sophisticated menus and "most comfortable armchairs in the world", Imperial Airways' Short C-Class flying-boats have long been held up as the last word in elegant travel. But were they? **RALPH PEGRAM** examines some contemporary customer reports to see if the reality matches the myth . . .

FLYING

A SERIES OF 48 — No. 47

COMFORT IN THE AIR.

In the 18-ton 200 m.p.h. Empire flying boats, Imperial Airways have excelled themselves in the provision of passenger accommodation. Comfortable sleeping berths, smoking cabin and promenade deck are some of the features which make these great flying boats the most luxurious of air liners. When looking at this photograph, which shows the interior of the promenade saloon, it is hard to realise that these happily engrossed people are several thousand feet above the earth.

Photo courtesy Imperial Airways.

The second Short S.23 Empire Flying Boat (the official designation had no hyphen in flying-boat), G-ADHM, was given the Imperial Airways "C-Class" name* Caledonia*, and was built specifically for the company's Atlantic routes with extra fuel tanks for extended range. It made its first transatlantic flight, from Foynes in Ireland to Botwood, Newfoundland, on July 5, 1937.
TAH ARCHIVE

"WE EXPECTED flying-boats that would not dissolve" — this was the caustic retort of a senior Imperial Airways Ltd (IAL) manager in 1939 commenting on the company's experience operating its Short "C-Class" or "Empire" flying-boats. These aircraft, the flagships of IAL's fleet, featured prominently in its advertising in the late 1930s and were portrayed as the epitome of travel by air; a view that persists today, usually with a sigh of nostalgia for a lost, luxurious "Golden Age". However, documents held in the Royal Aero Club Trust archive suggest that all may not have been a bed of roses for passengers or company when it came to the C-Class 'boats. How had the airliner come to be perceived so poorly from within?

A SHORT HISTORY

The British government's "chosen instrument", IAL had been formed in 1924 through the forced merger of several small private airlines and subsidised from public funds. At first the company ran several services into Europe, but these were gradually dropped in favour of the development of longer routes into the British Empire. By 1927 many of the European routes had been discontinued, leaving just Paris, Cologne and Zürich as destinations, while the Imperial Conference of 1926 had drawn up a framework for an Empire-wide service, formalised by the government in 1928.

Commercial operations commenced between Cairo in Egypt and Baghdad in Iraq, taking over from the RAF. The pioneering flight to the Far East in 1927 by the RAF using Supermarine Southampton flying-boats *[see Trevor Lipscombe's two-part series on the RAF Far East Flight in* TAH25 *and* TAH26 *— Ed.]*, and survey flights into Africa by Alan Cobham and others, provided the groundwork to underpin plans for route expansion. Diplomatic complications negotiating overflight and landing rights for some territories, and competition agreements with other airlines delayed matters, but were resolved in time.

By 1932, with most, but not yet all, of the routes agreed, IAL formulated ambitious plans to run an Empire-wide mail, passenger and light freight service. Its existing fleet of relatively new Short Kent flying-boats and Handley Page H.P.42 landplane airliners, supplemented by a collection of ageing types, was soon to be joined by the first aircraft of what could be termed

OPPOSITE PAGE ***Regardless of the reported discomforts of travelling by Imperial Airways flying-boat, the airline spared no expense on the trappings of glamorous travel; distinguished British illustrator Edward Bawden was commissioned to design a "Certificate of Contemporary Travel" for those crossing the equator during a flight.***

US LIBRARY OF CONGRESS

ABOVE ***A trio of typical aircraft operating commercial services in Africa in the 1930s, including two of IAL's most important landplanes; Handley Page H.P.42E G-AAUE*** **Hadrian** ***(furthest right) and Armstrong Whitworth AW.15 Atalanta G-ABTJ*** **Artemis,** ***behind Wilson Airways' de Havilland D.H.84 Dragon VP-KBG, at Kisumu in Kenya.***

the modern era; the cantilever monoplane Armstrong Whitworth AW.15 Atalanta, destined for African service. But to meet IAL's master plan it would be necessary to undertake major investment in new aircraft.

In early 1933 IAL Chairman Sir Eric Geddes submitted a detailed memorandum to the government, laying out the business case for an expanded Empire service to carry flat-rate air mail, the origin of the Empire Air Mail Service (EAMS) postulated by Assistant General Manager Sidney Dismore with the encouragement of the Colonial Office. The memorandum provided estimates of the traffic over the route network backed up by the cost, both in terms of capital investment and level of government subsidies required.

A VIEW OF THE FUTURE

In a document entitled *The Future of Civil Air Communications of the Empire*, dated March 27, 1933, the preamble sets out the intent.

"Apart from the London—Paris and London—Cologne services, which the Board regards as a 'shop window' but important for the maintenance of British prestige in Europe, the Civil Air Transport policy of His Majesty's Government [HMG] has been developed along Empire lines. So have been developed the London—Cape Town and the London—Karachi services; and soon, it is hoped, will develop the Australian service, via India, Burma and the Malay Peninsula, with an extension to New Zealand. Canada is the next Dominion with [which] we are in touch in the air, but the progress of invention and aeronautical science gives the Board every hope that, before long, a transatlantic service can be started with Canada, which can be linked up with a service from the east coast of Canada to Vancouver and beyond."

The argument for the fleet to be comprised of flying-boats was described thus:

"As far as the Board can see, and in accordance with the advice of its technical officers, although the very striking reduction in the cost-per-capacity-ton-mile has been attained largely by the development of progressively larger aircraft, yet it appears that land aircraft may well be approaching the maximum size which will be economically possible. Large marine aircraft do not appear to offer the serious mooring and airport problems which attend large land aircraft.

"The Board visualises the future as presenting greater opportunities for the development of our Empire air routes by marine aircraft than by land aircraft, and contemplates linking inland cities with the 'through' marine aircraft at points along the coast by land aircraft.

"Summary: the Board thinks that, in great measure, the future of air communications within the Empire lies in marine aircraft, and that we should . . . lean more and more to our national heritage, the sea. The influence of our naval power in the past centuries has provided us with marine airports, on a scale to which no other country can aspire. Such a policy as is forecast has many political, economic and technical advantages, which cannot be equalled in the development of land-aircraft services in our Empire communications, or anywhere else."

This all met with a favourable response from the government, and the EAMS was approved

AUTHOR'S COLLECTION

ABOVE ***The first C-Class flying-boat, G-ADHL, named* Canopus *after the pilot of King Menelaus of Sparta's ship during the Trojan War, made its first flight on July 3, 1936. As delivered to IAL,* Canopus *had a cruising speed of 165 m.p.h. (265km/h) at 510 h.p. (of 910 h.p. for take-off) and a range of 760 miles (1,220km) at 165 m.p.h. in still air.***

by parliament in late 1934, with plans to commence in 1937. Imperial had taken steps already to initialise its plan.

No doubt preliminary discussions were held with those British companies that specialised in flying-boats — Short Bros, Blackburn, Supermarine and Saunders-Roe — yet in 1933 none appear to have produced even speculative designs appropriate for the airline's future needs; in fact only the first two are known to have had any large civil designs in mind.

After full deliberation IAL issued a draught specification for four-engined flying-boats, almost certainly compiled by its technical consultant, Maj Robert H. Mayo, in March 1934. The outline stated the following:

"This outline has been prepared for the guidance of those who are invited to submit tenders . . . and that the basic principle observed in its preparation is a desire to give manufacturers the greatest possible freedom for the expression of their own ideas while requiring [the] greatest safety and lowest cost of operation.

"We have, in consequence, specified only those essentials which arise from (i) study of general characteristics of the type of aircraft for which we now desire tenders and (ii) our own experience in the operation of aircraft.

"Tenderers are especially invited to offer alternatives which they may consider superior to any suggestions or equipment mentioned in this outline specification."

Air-cooled engines of around 500 h.p. cruising power were indicated as preferred, but not essential, and the airline provided full details of the required cockpit instrumentation and the appropriate standard of cabin accommodation. The aircraft had to meet the following criteria:

- provision for fitting a land undercarriage for use around seven to ten per cent of the aircraft's operating life;
- a crew of five — 1,000lb (455kg);
- a payload (passengers, baggage and mail) of 7,200lb (3,265kg);
- interior space to provide suitable accommodation for permutations of the following: up to 6,200lb (2,810kg) of mail; up to 24 day-passengers at 165lb (75kg) each plus 85lb (38kg) baggage each; up to 16 night-passengers at 165lb each plus 85lb baggage each;
- a cruising speed of more than 150 m.p.h. (240km/h) at 5,000ft (1,520m);
- a range at cruising speed of 500 miles (800km) against a 40 m.p.h. (64km/h) headwind.

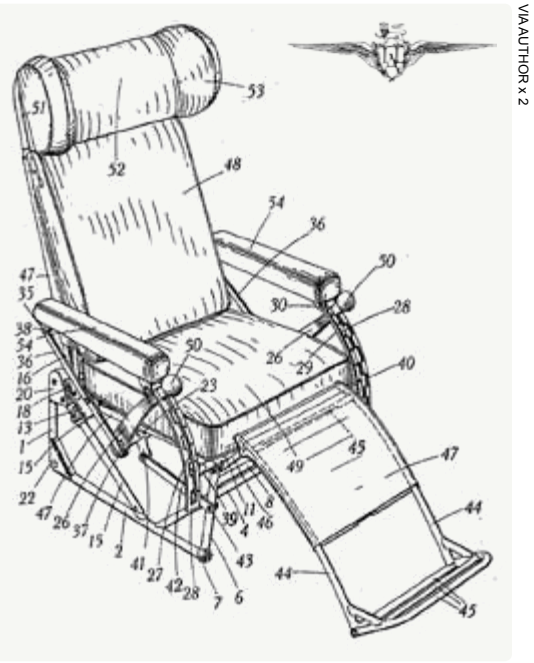
This was tweaked considerably over the following months; most notably the requirement for an undercarriage was discarded and the payload increased to 8,200lb (3,720kg). Short Bros tendered its S.23 project to IAL in June 1934.

THE "C-CLASS" FLYING-BOAT

Throughout 1933 designer Arthur Gouge and his team at Short had been working on the design of the S.21, a braced parasol-wing monoplane powered by two Rolls-Royce Buzzards, intended as both a civil flying-boat and as the lower component for the Mayo Composite aircraft, for which the company had been awarded a contract under Air Ministry (AM) Specification 13/33. It is plausible that the initial concept for the S.23 could have been planned along parallel lines. However, when the AM issued

ABOVE ***A contemporary colour cutaway illustration of C-Class flying-boat G-AEUA* Calypso*, used by IAL for promotional purposes. In this illustration, the aircraft is shown with the internal configuration used on the Empire Air Mail Service (EAMS) routes, after IAL deleted the sleeping bunks and moved the Flight Clerk into what had been the smoking cabin.***

RIGHT ***Imperial paid a great deal of attention to detail in the appointment of the C-Class cabins, and patented its own specialised design for a lightweight reclining chair. At least one still exists and is, at time of press, for sale on a popular online marketplace website!***



VIA AUTHOR x 2

Specification R.2/33 for a large four-engined maritime patrol flying-boat, Gouge concluded that a more advanced scheme would best satisfy all three projects and they were developed along a shared design trajectory. The latter scheme incorporated a tall hull with a shoulder-mounted cantilever monoplane wing, a planing bottom of high length-to-width ratio, a lattice wingspar of rectangular box form and large area-increasing wing flaps. In combination these resulted in a major step forward in flying-boat design and a considerable advance over the designs of the manufacturer's peers. The complete redesign of the S.21 became the *Maia* lower element of the Mayo Composite and the S.25 the Sunderland.

In January 1935, despite the array of novel features in the S.23 design, IAL took the bold decision to order the type straight off the drawing board; initially just two examples, but by the end of the year orders had risen to 28 in three tranches. The first aircraft, named *Canopus* by IAL, made its first flight on July 3, 1936.

Before the aircraft entered service IAL made the decision to schedule flights during daylight hours only and hence the requirement for bunks and bedding to be carried was dropped. For the aircraft assigned to the EAMS routes, seating was provided for 15–17 passengers, reduced after the forward smoking cabin was reassigned as the Flight Clerk's office. The seats were of a special lightweight reclining design for which IAL held patents, and the passenger cabins were notably tall and spacious.

EARLY SERVICE EXPERIENCE

The S.23, referred to by IAL as the "C-Class" or "Empire" flying-boat, was an advanced aircraft for its era, and its introduction into service proved a mammoth undertaking. Not only did this require the rapid recruitment and training

LEFT ***Another piece of ingenious engineering applied to the S.23 by Short Bros was the provision of work platforms that folded out from the leading edge of the wing. Engineers were able to service the Pegasus engines from the platforms without the need to beach the flying-boat. Hoists could be mounted on the engine nacelles to remove or install the engines.*** TAH ARCHIVE

BELOW ***Named* Ceres *after the Roman goddess of agriculture, S.23 G-AETX made its first flight in July 1937, and was used to survey the IAL route from Alexandria in Egypt to Karachi in India (now Pakistan) via Habbaniyah in Iraq and Sharjah in the Persian Gulf two months later. It was destroyed by an explosion while moored at Durban in December 1942.***

of pilots and aircrew for an aircraft unlike any they would have flown before, but also the provision of extensive mooring, docking and servicing facilities along the expanding network of new routes. Control boats, tenders and fuel vessels were ordered to provide support at the numerous landing points, and contracts issued for the transfer of passengers to their hotels or landing grounds for connecting flights. The aircraft were required to fly in all climates, from bleak European winters to Equatorial heat and tropical storms, and to operate from the saltwater of the sea to freshwater at altitudes over 3,000ft (900m). For IAL this was the dawn of the true modern era of commercial flying, complex and prone to logistical headaches.

Two of the first batch of aircraft were earmarked for route-proving transatlantic flights, and later another two were allocated to undertake experiments with inflight refuelling. Both projects required a great deal of technical support above and beyond the normal commercial operation of the aircraft.

From the pilot's perspective, the C-Class flying-boats performed well both on the water and in the air, although both taking off and alighting could prove tricky if the flaps were not set correctly, and this resulted in a number of accidents. Adverse airflow over the flaps from the outlets of the oil coolers in the wings was suspected to have contributed to at least one alighting accident. On the whole, though, it was judged to be a good aircraft to fly.

One excellent feature was the provision of hinged panels in the wing's leading edge, providing formed platforms from which to service the engines — invaluable at remote locations along the route. When engine repairs could not be performed it was possible to fly back to the UK on three engines. The Bristol Pegasus engine was already in use in military and civil aircraft and had a proven track record. Although there were the usual incidents of fouled plugs and minor leaks, it was not noted as an unreliable unit, although in the C-Class 'boats the carburettors were liable to ice up and cause engine failure. Two fatal crashes were attributed to this.

The claim by flying-boat advocates that water was a more benign surface from which to operate than land proved overly optimistic. Hidden rocks, sandbanks and floating objects were a constant hazard, as were adverse currents, tides and swell. All, at one time or

TAH ARCHIVE

AUTHOR'S COLLECTION

ABOVE ***At most stops along Imperial's routes customers were transferred to and from the aircraft by launch, as seen here as passengers board G-ADUX, named*** **Cassiopeia** ***after the mother of Andromeda in Greek mythology. It was only in April 1938 that a dedicated mooring jetty was constructed at Imperial's base at Southampton Docks.***

VAI AUTHOR x 2

ABOVE LEFT ***A novel feature of the C-Class was the "Promenade Deck", a rather grand name for a wide side-aisle in the centre cabin, appointed with a handrail and eye-level windows for observation.*** **ABOVE RIGHT** ***Promotional photos of passengers enjoying sumptuous levels of comfort were almost certainly taken in a cabin mock-up!***

TAH ARCHIVE

ABOVE ***Imperial's marketing department emphasised the luxury available aboard its C-Class 'boats. This posed photo of relaxed, happy passengers was used on a Senior Service cigarette card entitled "Comfort in the Air", which read: "It is hard to realise that these happily engrossed people are several thousand feet above the Earth".***

another, were to cause damage to examples of the aircraft. Hulls were dented and holed and the ingress of seawater certainly resulted in localised corrosion. Experience showed that the thickness of the Alclad plating of the lower hull and planing bottom was inadequate, and a programme to replace these with more robust plates and additional stringers was instigated in 1939. Upgraded aircraft in the later batch of IAL orders — nine S.30s and two S.33s — had these fitted from the start. Recovery, dismantling and, hopefully, repair of damaged and partly submerged aircraft was a herculean task which could take weeks or even months.

Between the autumn of 1936 and the outbreak of war in 1939, IAL took delivery of 40 C-Class 'boats (of the total of 42 built — the two S.33s were not completed until 1940), not far short of doubling the size of its fleet; a terrific expansion of its operations that placed a great strain on the organisation. To add to IAL's woes eight were written-off in accidents, with the deaths of 18 passengers and crew. For an airline that prided itself on its safety record this was a major blow.

VIEW FROM THE CABIN

There is a general assumption, repeated in numerous books and magazines, that IAL's flying-boats provided a famously luxurious service, superior to that of any of its rivals. The airline's advertising certainly implied as much, mainly through the use of colourful artwork, although "comfort" was the word most commonly used, rather than "luxury". Publicity photographs of the C-Class 'boats featuring groups of smiling passengers relaxing while drinking cocktails, strolling around the cabin and admiring the view below were, as you might expect, mostly taken in the mock-up at Short's factory. So, the question is, how much of this image was just the creation of advertising copywriters and artists?

It is hardly surprising that some 75 per cent of passengers on the Empire routes were airline staff, government officials, military personnel and senior businessmen, as only the seriously wealthy could afford both the time and money for long-distance flying on personal trips or holidays. Their expectations could be very different. The public servants were, on the whole, stoic in their attitude to the service provided, maintaining the characteristic British "stiff upper lip", but far less so many others who were often vocal in their feedback.

A journey from London to Sydney involved seven overnight hotel stops. To Durban there were six. On both routes, departure times each day could be as early as 0400hr and most were before 0700hr, necessitating being woken an hour or two earlier. There were generally three or four intermediate ports of call on each stage before arriving in the late afternoon at the next hotel. Longer journeys were, by any standards, somewhat less than relaxing.

Overnight stays were arranged in a string

LEFT ***This stylish route map from a contemporary IAL brochure shows the numerous stops on the C-Class flying-boat route from the UK to Australia, with a spur to Hong Kong from Bangkok, including sections flown by Qantas Empire Airways and Indian Trans-Continental Airways.*** **BOTTOM LEFT** ***An IAL promotional item extolling the virtues of "the most comfortable armchairs in the world . . ."*** VIA AUTHOR x 2

of hotels along the route and the quality of accommodation and service varied considerably. Imperial endeavoured to ensure that appropriate standards were upheld, but it was inevitable that problems would arise, tainting the experience of passengers, which no doubt had a strong influence on their perception of the whole trip. There were common threads, however, in the complaints regarding the aircraft themselves.

HEATING

Heat for the cabins was provided by warming ventilation air drawn from an intake in the port wing's leading edge via a heat-exchanger fed from a water-boiler muff wrapped around the exhaust pipe of the inner starboard engine. This proved to be wholly inadequate, was never truly resolved, and led to a raft of complaints, as the following litany of grumbles demonstrates:

"Could something be done about heating the flying-boats in the depth of winter? It was exceedingly cold and no heat was available."

"By the way, have a look at the present system of heating. You may find it very good — provided it works at all."

"I think in winter it would be a good idea to provide hand muffs as well as foot muffs! Also perhaps hot water bottles!"

"Every endeavour should be made to keep the temperature up [in the cabin] when the aeroplane rises to high altitude."

"My only criticism is that the heating appears to fail at high altitudes."

"[The] prevention of [the] freezing-up of [the] heating system . . . should receive further consideration."

"My regret is that the 'planes were not heated, and I consider it a grave defect, if not wicked."

"Once again the heating was not working and it was so cold over the mountains behind Marseille that one's eyelashes froze together."

"You may have refrigerators on board — certainly no heaters."

"I think some heating should be adopted when flying at high altitude."

"Flying from Alexandria to Rome, in spite of a footsack, two rugs and a leather coat, [I was] chilled to the bone."

"For eight hours the temperature in the cabins was about 40°F [4°C] — unbearable!"

"You must do something about heating the flying-boats if you wish to satisfy your passengers — I have been numb physically

RIGHT ***A similar map charting the route from the UK down through Africa to Durban in South Africa. Spur routes in this case were flown by Wilson Airways, Elders Colonial Airways and Rhodesian & Nyasaland Airways "in association with Imperial Airways".*** **BOTTOM RIGHT** ***Another IAL promotional item, this time pointing out the benefits of the promenade deck, providing "plenty of room to walk about".*** VIA AUTHOR x 2

and mentally throughout the whole journey on account of the biting cold."

"The heating stove had given out and the temperature was very, very cold at any height."

". . . and worse than that, there was no adequate provision made for warmth while we were flying across France, at a temperature of 12°F [-11°C]."

"My only complaint is that the heating is quite hopeless . . . I was practically frozen."

FOOD AND MAIL CARRIAGE

The in-flight menus that have survived certainly look lavish but may not be representative of typical meals. As there were no facilities to cook or even heat food aboard, all meals were prepared by onshore caterers along the route and stored in large vacuum flasks in the galley. Consequently the temperature of the food varied considerably, not aided by the problems with cabin heating, as the following passengers' remarks reveal:

"Hot meals are only lukewarm."

"The food on this homeward flight was beastly and cold."

"It appears to me that possibly some arrangement could be designed whereby the excellent food that is provided could be served rather hotter."

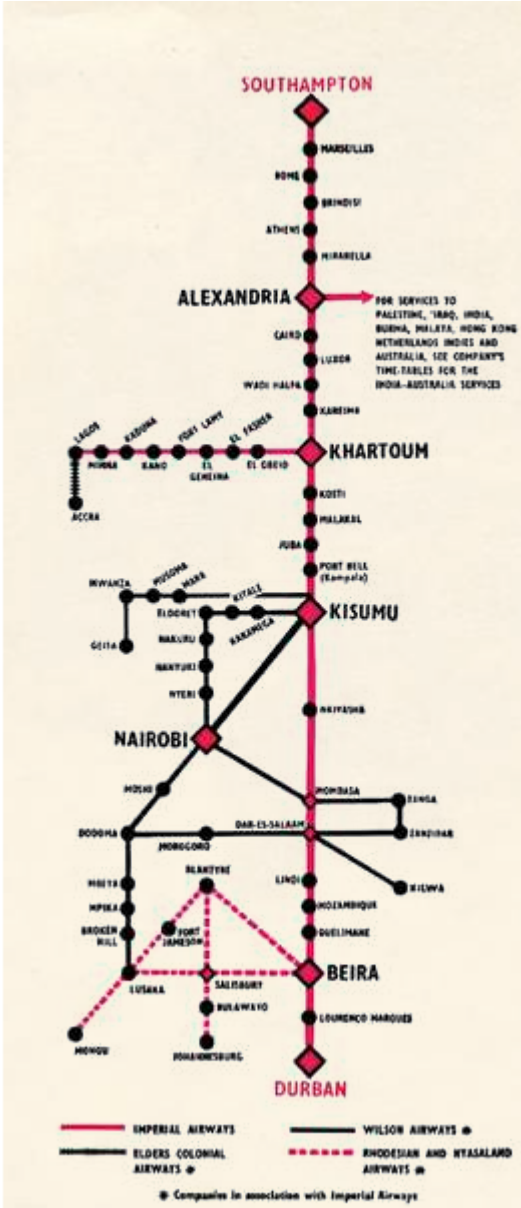
"With that temperature the food served was necessarily cold."

Imperial's substantial subsidy was entirely dependent on the carriage of mail, with large penalties for late delivery, hence flight schedules prioritised mail over the needs or desires of passengers. To meet tight deadlines, passengers could be asked to be ready to board very early in the morning, and advertised flight schedules were liable to be adjusted with little prior warning. On occasions, the carriage of passengers would be suspended at short notice, a point not appreciated by travellers:

"I wish that mails and passengers were carried separately, so that in difficult flying conditions there is not such an urgent need for speed to ensure the punctual arrival of mails at the cost of extremely tired passengers."

"It was discovered that with new passengers and mails the 'plane would be overloaded. So those who had paid for excess baggage had to leave it behind."

"I look for the day when there will be passenger flying-boats when human beings won't



LEFT ***A beautifully minimalist contemporary Imperial Airways timetable detailing the flying-boat service from the UK to Egypt. Services to Australia and down through Africa both routed through Alexandria in Egypt, via St Nazaire and Marseille in France, Rome and Brindisi in Italy and Athens and Mirabella Bay (Crete) in the Greek islands.*** VIA AUTHOR

have to be sacrificed to the Moloch of Mails."

"Nothing is more maddening than to have paid a high price for a ticket and to discover that, owing to the weight of mail carried, the journey could have been completed as quickly by train."

"I urgently recommend that the policy be altered to passengers first and mail second."

"When I tried to book in June three seats to fly to Australia in December . . . they could not book the seats, because they were likely to have a large amount of Christmas mail in December. They recommended me to go to the Dutch company [KLM]."

ANOTHER DISSATISFIED CUSTOMER

While most travellers had an uneventful journey in the air, during transfer to and from shore and in the hotels some suffered badly, and made their feelings regarding IAL known. The aircraft's crew were rarely the subject of complaint but the airline itself came in for stinging criticism, as the following passengers' remarks show:

"I have done a fair amount of long-distance flying but this is the first time on Imperial Airways — and the last."

"When I booked my passage home and return, 50 per cent of the people I informed said 'people never travel twice by Imperial'."

"Owing to your high fares and non-quick route to the Gold Coast, I travelled by Air France."

On the lighter side, trying to please all passengers all the time was an uphill battle, and the strangest things came in for both positive and negative comment, the cutlery seemingly being a particular point of irritation:

"The handles of the spoons and forks turn up the wrong way and stick into one's palms."

"The forks should have straight handles. They are bent the wrong way and difficult to hold."

"The lined paper bags in the pocket in the backs of chairs found in Air France are handy and unobtrusive and it is a moral support to feel that one may be sick decently and quietly at any moment!"

"I carry my own rugs and never go to the lavatory on board."

There were positive comments too, however, even if some were somewhat qualified:

"I enjoyed particularly — marmalade."

"Your camembert was excellent but otherwise one couldn't call it 'travel de luxe'."

"Having lost my things in the crash, I appreciated the kindness and trouble taken in obtaining some more."

As IAL prepared for its forced merger with British Airways to form the British Overseas Airways Corporation (BOAC) in 1939, discussions commenced on plans for the future fleet, including a replacement for the C-Class flying-boats on the Empire routes. Robert Mayo had stood down as General Manager (Technical), a role he had held since 1936, but was still acting as a consultant. In a report circulated to IAL's senior management in September 1939, regarding replacement of the fleet under the EAMS, he wrote:

"For the convenience of passengers and the handling of mail and freight, there can be no doubt that experience has shown that the landplane is far superior to the flying-boat, while there is probably not a single member of the technical staff with experience of land and marine types who would not prefer to operate and maintain landplanes rather than flying-boats, provided their general safety is comparable.

"It is suggested that it would be far better at this stage to admit that flying-boats are not the solution for these comparatively short-range services (750 miles), and cut such losses

TAH ARCHIVE

ABOVE ***The cockpit of the C-Class flying-boat was remarkably spacious with excellent visibility afforded by the generous glazing wrapped around the upper forward fuselage. Stations for captain and first officer were provided side-by-side with dual controls, aft of which were the radio officer's control panel and an auxiliary power unit.***

as have been incurred rather than maintain a policy which will not regain for the company its pre-eminence on these routes. It is therefore recommended that the decision should be taken to return to a landplane type that is well within the limits of present-day practice."

WAR HAMPERS DEVELOPMENT

This did not go down at all well with some IAL managers, and, despite the outbreak of war having put paid to any change to the fleet, one commented on Mayo's report. It is not clear from surviving documents who this may have been, but it was obviously someone with intimate knowledge of C-Class operations, quite possibly Maj Herbert Brackley, IAL's Air Superintendent. These were particularly stressful times for the airline staff. No doubt the atmosphere was tense as IAL struggled to complete the BOAC merger and deal with the government's requisition of its aircraft and the relocation of its operational bases. So it is no great surprise that the response to Mayo's report was terse and a tad cynical:

"The objective of the flying-boat exponents was the development of larger and faster units with increasing range carrying the largest practicable volume of traffic.

"Operations with the actual C-Class flying-boats have fallen short of expectations. We expected to have, but did not get:

a) [flying-] boats which were strong enough;
b) 'boats which would not 'dissolve' in seawater;
c) reliable engines;
d) a specially constructed marine airport and base in the United Kingdom;
e) 'boats which would carry the specified payload with day and night equipment;
f) access to the shore by pontoons or rafts at practically all places (like Pan American have had for years in the Caribbean);
g) units which could fly out and home with the minimum of maintenance;
h) landplanes to run part of the services, and last but not least;
i) the same support from the government as was promised when the scheme was first adopted."

FAIR COMMENT?

Certainly, the S.23 was found to be rather too susceptible to hull damage, both above and below the waterline, but this was easily remedied. In all other regards it was a robust aircraft, and several served well beyond the expected design lifetime of their wing spars, despite the rigours of operating throughout the war. The use of the word "dissolve" was

"SO WHAT OF THE MUCH-VAUNTED 'GOLDEN AGE' OF LUXURY? BEING CONFINED IN A NOISY METAL BOX FLYING THROUGH THE TURBULENT LOWER ATMOSPHERE FOR MANY HOURS WAS COMFORTABLE AT BEST . . ."

TAH ARCHIVE

ABOVE ***The career of G-AETW* Calpurnia *was comparatively short; having made its first flight at the end of June 1937, it crashed in Lake Habbaniyah during a sandstorm at night on November 27, 1938, Capt Attwood, First Officer Spottiswoode and two passengers being killed. The all-important Christmas mail was rescued, however.***

an exaggeration to make a point about damage sustained when the hull was holed; in fact, the Alclad structure was no more prone to corrosion than that of any other comparable flying-boat. The S.23 met the terms of the specification regarding load, so the complaint about payload and night equipment is odd, especially as it appears to have been IAL's choice to run only a daytime service.

The Pegasus engine was not a notably unreliable engine but catastrophic failures resulting in two fatal crashes were clearly unacceptable. For the IAL engineering staff called upon to undertake maintenance and repairs at remote locations it was a serious challenge and could not always be completed. Similarly, there was a limit to how much general upkeep and repair of the airframe could be undertaken while afloat or beached, without the need to return to the UK. This could truly not be blamed on the aircraft; it was a problem inherent in the use of flying-boats.

All in all, the C-Class flying-boat was a good aircraft, tasked to shoulder the burden of the expanded route network without the support of its planned landplane equivalent, the Armstrong Whitworth A.W.27 Ensign. The remaining points in the note addressed the operations and not the aircraft and served merely to validate Mayo's analysis of the difficulties inherent in running a long-distance all-flying-boat service.

So what of the much-vaunted "Golden Age" of luxury? Lengthy journeys by air were not, as indeed they are not now, luxurious. Being confined in a noisy metal box flying through the turbulent lower atmosphere for many hours was, if you were lucky, comfortable at best. In a cold, rain-lashed European winter, playing second fiddle to sacks full of Christmas mail, served lukewarm food in a chilly cabin and roused in the wee small hours of the morning for the next leg of the journey would test anyone's patience. And on top of that the fork handles bent the wrong way . . .

BELOW **Capella** ***(G-ADUY) came to grief at Batavia on Java in March 1939. The C-Class fleet suffered a remarkable attrition rate, some 19 of the 31 S.23s built being lost to various causes including taxying accidents, crashes and enemy action during the war. Five of the nine S.30s were also lost, along with one of the two S.33s completed.***

TAH ARCHIVE

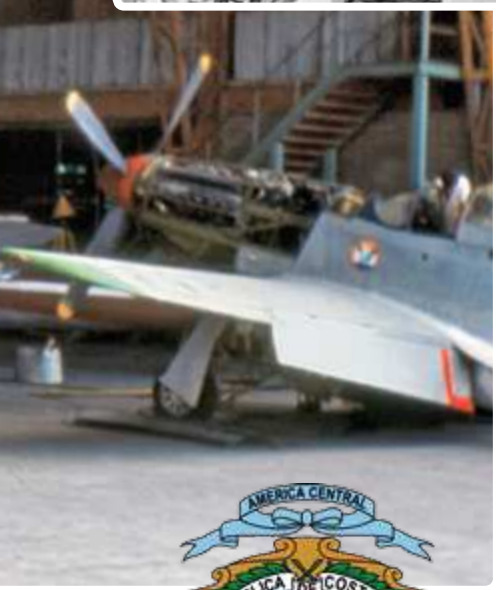
WILL MARTIN VIA AUTHOR

THE WORLD'S SMALLEST FIGHTER FORCE

COSTA RICA'S NORTH AMERICAN F-51D MUSTANGS, 1955–64

In the mid-1950s the Costa Rican government acquired four examples of the North American thoroughbred from the Texas National Air Guard — despite having no formal air force — in order to discourage air attacks by local rebel forces. Two were lost in short order, and the other two spent most of their time on the ground, as **LEIF HELLSTRÖM** reveals

GEORGE SILK VIA AUTHOR



TOP ***F-51D Mustang No 4 during the 1955 emergency. The original Costa Rican national insignia was essentially the USAF's "stars and bars" minus the star element!***

MAIN PICTURE ***Surviving Mustangs No 4 (44-74978) and No 1 (44-73193) in the SALA maintenance hangar in San José in 1964, before leaving Costa Rica. By this time the shield from the Costa Rican coat of arms*** **(ABOVE)** ***had been added to the national insignia.***

THE CENTRAL AMERICAN republic of Costa Rica, sandwiched between Nicaragua and Panama, has the distinction of having fielded what was probably the smallest ever fighter aircraft force of any country. In January 1955 Nicaragua-based followers of Rafael Ángel Calderón Guardia, President of Costa Rica during 1940–44, known as *Calderonistas*, mounted incursions into Costa Rica supported by a few aircraft, including at least one Republic F-47 Thunderbolt. At this time Costa Rica had no air force, but after an appeal to the Organization of American States (OAS), established in April 1948, the USA quickly provided four North American F-51Ds from the Texas Air National Guard. The Mustangs arrived in Costa Rica within days, and their presence apparently discouraged further air incursions by the rebels.

Two of the Mustangs — flown by seconded airline pilots — were lost in accidents in the first year, but the remaining pair formed the entire fighter power of the reconstituted *Fuerza Aérea Costariccense* (FAC). They saw very little further use, however; and, although kept in spotless condition, were deliberately disabled by breaking the points on the magnetos to ensure the aircraft could not be used in a coup.

BACK TO THE USA

By 1958 the Costa Ricans considered selling the two Mustangs. Over the years there was interest shown by Cuba — both Batista and Castro forces — Guatemala, Indonesia and Panama, but it took until March 1964 before the Mustangs were finally sold, to the MACO Corporation in the USA, which had previously also bought Nicaragua's surviving Mustangs for resale on the civilian market.

Since the aircraft had been stored for some time, they were towed over to the SALA maintenance company in the Costa Rican capital, San José, for a full inspection and overhaul. On June 13, 1964, Will Martin of MACO took off in the former FAC No 1, now registered N6170U, for a ferry flight to the USA. But he only made it as far as Nicaragua before the engine failed and he had to make a belly-landing in a field. Martin survived, but the aircraft was damaged beyond repair.

The other Mustang, formerly No 4, registered as N6169U, made it back to the USA. It was reportedly destroyed in a hangar fire in 1988, by then registered N74978 (after its USAF serial 44-74978) — but its identity lives on with a restored Mustang currently based in Florida.

A QUESTION OF CALIBRE

WHY DID THE RAF PERSIST WITH THE 0·303IN MACHINE-GUN?

In response to Greg Baughen's article in *TAH32* on the RAF's readiness for war in 1940, reader Richard Davis asked a very good question — "why did we go to war with pop guns?" — i.e. 0·303in-calibre rather than 0·50in machine-guns? *TAH's* armament specialist **MARK RUSSELL** explains the rationale behind the RAF sticking with the ubiquitous 0·303in

THE QUESTION OF why the RAF stuck with the 0·303in-calibre machine-gun during the inter-war period — and even well into the Second World War — instead of using the 0·50in-calibre, as used by the USAAF (the Luftwaffe also opted for larger-calibre machine-guns as standard) has long been discussed. This article takes a look at why the RAF chose to standardise on 0·303in guns and assesses if this was a reasonable decision; and considers the armament of both fighters and bombers.

THE HERITAGE OF THE 0·303IN GUN

Ammunition of 0·303in-calibre had been the British military's choice since it began using the machine-gun, and the Royal Flying Corps (RFC), as part of the regular British Army, therefore adopted the same proven designs during the First World War. The 0·303in was also entirely fit for purpose in terms of its ability to destroy aircraft of the time; and, while the RFC/RAF experimented with heavier-calibre guns for attacking Zeppelins during the First World War, and continued these experiments during the inter-war period *[see the author's* Bring out the Big Guns *in* TAH28 *— Ed.]*, these heavier-calibre guns were only ever envisaged as being used in specialist aircraft focused on the bomber-destroyer role. The machine-gun was still seen as the key air-to-air weapon for both fighters and bombers.

The RAF had thus to an extent "inherited" the 0·303in machine-gun and, given that it had proved to be effective in the First World War, it is understandable why the air arm persisted with it into the 1930s; until the advent of metal-framed, and ultimately all-metal aircraft, there was no reason to see it as being unable to do the job in future. Having said that, towards the end of the First World War armour had begun to be introduced in ground-attack aircraft, and so the RAF started to think that a 0·50in-calibre gun would need to be the standard aircraft weapon to cope with aircraft armoured in this way.

The RAF itself chose performance over armour, however, so in the 1920s and into the 1930s the RAF did not armour its fighters. Wartime armament specialist G.F. Wallace believed that this led the RAF to sideline the 0·50in gun. In addition, it was felt that the extra power of the 0·50in round was not needed on fighter aircraft structures at that time, since they were not armoured.

Yet the 0·50in gun was not wholly dismissed. The RAF and Air Ministry continued to consider whether a Vickers gun of this calibre could replace the standard Vickers 0·303in gun, but in 1928 finally decided that the 0·50in gun "had no sufficient advantage over the 0·303in weapon".[1] There were also considerations of economy at play; the RAF had large stocks of 0·303in guns and were expected to use the same ammunition as the Army (which used cordite as the propellant), both factors which militated against any attempt by the RAF to go its own way.[2] The nitro-glycerine-based cordite was less than ideal as a propellant for various reasons, one of which was that it could "cook off" in the breech and explode, unlike the more stable nitro-cellulose propellants used by other nations.[3] For aircraft this required guns to be redesigned so they did not have a round left in the breech once they had finished firing, which took time and expense. Also the ammunition used by the RAF had to have rimmed cartridges so it could be transferred to the Army if necessary. Most other machine-gun

TAH ARCHIVE X 2

ABOVE ***The Browning 0·50in rimless round (left) and a British rimmed 0·303in round side by side, illustrating the considerable difference in size between the two. As the British Army used 0·303in rimmed ammunition for its rifles and machine-guns, it was thought that it would be wise for the RAF to standardise on the same, despite rimless rounds being better for machine-guns.***

LEFT ***In common with its RAF fighter and bomber contemporaries, the Fairey Battle light bomber was fitted with 0·303in-calibre machine-guns — a fixed forward-firing Browning in the starboard wing and a Vickers K on a Fairey high-speed mounting in the rear of the cockpit, which, curiously, in this case is fitted with a 0·303in Lewis gun.***

TAH ARCHIVE

ABOVE ***Armourers work on the barrels of 0·303in Browning machine-guns in the wings of a Hawker Hurricane, probably during the Battle of France. The Hurricane was fitted with eight Brownings, Air Ministry Specification F.5/34 having stipulated six or eight 0·303in Browning machine-guns, each of 300 rounds, to give 15sec of fire.***

ammunition was rimless, which meant that guns from outside the UK required a further redesign so they could fire rimmed cartridges.[4]

The introduction of metal aircraft, together with the resulting increase in aircraft speeds, reignited the debate about the effectiveness of 0·303in. These changes in airframe structure made aircraft stronger, while the increase in speed potentially meant less time to fire at the target.

As it entered the 1930s the RAF recognised the problem presented by bomber formations flying at high speed and able to defend themselves against fighter attack, as this was the assumption at the heart of the RAF's own bomber doctrine. The RAF looked at both increasing the number of guns on single-seat fighters and developing multi-seat fighters with turrets, in which the gunner would be able to aim his (potentially heavier-calibre) guns at the bomber formation.

In his 2014 book *The Royal Air Force and Aircraft Design 1923–1929*, Colin Sinnott provides a good analysis of the discussions within the RAF over the types of fighter to be developed and of the guns with which they should be armed.[5] The result was that the 1930s saw the RAF go from squadron aircraft capable of 200 m.p.h. (320km/h) with two guns (the Hawker Fury from May 1931) to 315 m.p.h. (505km/h) and eight guns (the Hurricane from June 1938); a huge leap.

In looking at firepower, the RAF focused primarily on fighter armament. The needs of the bomber (which was expected to operate in daylight) were met by a combination of formation flying, with the number of guns in the formation seen as adequate to meet any attack, and power-operated turrets, in which the RAF led the world, having been the first to introduce them in the Boulton Paul Overstrand in January 1935.[6]

FIGHTER ARMAMENT

Looking first at fighter armament, throughout the 1920s and 1930s the Air Ministry (AM) had considered the best calibre for aircraft guns. Held by The National Archives at Kew, AM document AIR 2/347 describes the RAF's analysis of the results of trials in the USA in 1927 with 0·30in and 0·50in guns. The British Air Attaché in Washington DC, who supplied the US Navy report, stated that it was "obtained indirectly" and should therefore be treated as "strictly confidential".[7] The Assistant Director, Research & Development, Armaments, was dismissive, opining that the American trial "jumps to conclusions with very little evidence".[8] However, Minute 13 from the Deputy Chief of the Air Staff (DCAS) to the Chief of the Air Staff (CAS) states that the American trials show that "the Americans suspect what [the Royal Aircraft Establishment at] Farnborough has shown to be the case; namely that the ½in bullet is, against aircraft, not markedly superior to the 0·303in".

The CAS concluded on July 3, 1928, that "there is nothing in this to cause us to change our policy".

TAH ARCHIVE

ABOVE ***Practice makes perfect — a gunner undertakes some shooting practice from a ground-fixed turret fitted with a 0·303in Vickers K (also known as the Vickers Gas Operated — VGO) machine-gun. The VGO entered service with the RAF in 1937, and was particularly suited to aircraft in which ammo belts and boxes could not be fitted.***

Group Captain Claude H. Keith described the 0·50in gun as "neither fish nor fowl", being not much more effective than the 0·303in gun and unlikely to be able to penetrate the armour it was felt the Luftwaffe might install.[9] The latter would require a 20mm cannon to be certain of inflicting serious damage, and so the RAF bypassed the 0·50in machine gun to develop the 20mm cannon for fighters, being "pretty certain that no aircraft could afford to carry protection against a 20mm-calibre shell".[10] The RAF had thus clearly looked at the question of whether the 0·303in or the 0·50in gun should be used in future plans, and made an entirely sensible decision to go with the 0·303in machine-gun and look at 20mm cannon as the next level of fighter armament.

The question, then, was how many 0·303in guns should be used? The decision to specify eight 0·303in guns in AM Specification F.5/34 in November 1934 (which ultimately led to the Spitfire and Hurricane being armed in this way) was based on a series of trials from the early part of 1933, as described by Keith.[11] He goes on to describe a meeting of July 19, 1934, in which the trials were discussed and the conclusion drawn that eight guns firing 1,000 rounds a minute would be needed in the new fighters.[12]

A meeting of the Operational Requirements Committee to finalise F.5/34 on August 9, 1934, noted that "eight guns should be aimed at, on grounds of shorter time to obtain the required density and the improvement in range which was obtainable with more guns".[13] So the concept of more guns was clearly seen, based on tests, as necessary to deliver the weight of fire needed to deliver a killing blow in the short time available to a fighter in the new high-speed air combats that were envisaged.

Specification F.5/34 led to the development of fighters equipped with eight 0·303in guns; a choice which Sinnott describes as "far ahead" of any other air force — justifiably so, given that at the time the German Messerschmitt Bf 109 was being designed to carry two 7·9mm (0·311in) machine-guns, later increased to four.[14] Certainly for fighters, the RAF did not see the eight-0·303in-gun fighter as the final solution to the question of fighter armament; the following year's Specification F.37/35 (which ultimately led to the Westland Whirlwind) eventually called for four 20mm cannon (although the initial Specification issued to manufacturers in April 1935 called for six or eight machine-guns).[15]

This latter change of armament was seen as delivering "a fighter superior to anything we know of elsewhere"; a reasonable conclusion at that stage.[16] However, see Matt Bearman's article *The Whirlwind Becalmed* in *TAH20* for an analysis of why the Westland fighter was not the complete success this quote suggested, largely for reasons unrelated to armament.[17] The RAF also continued to look at even heavier weapons and investigated

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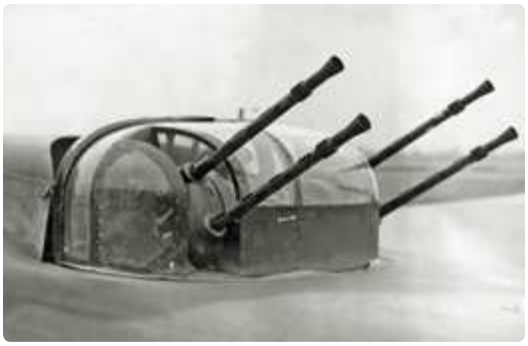
ABOVE ***Air Ministry Specification F.9/35 called for a two-seat "Day and Night Fighter" fitted with a "midships turret armament", resulting in the Boulton Paul Defiant, the prototype of which, K8310, is seen here fitted with the company's own Type A powered turret design, accommodating four 0·303in Browning machine-guns. No forward-firing armament was fitted.***



TAH ARCHIVE

RIGHT ***Four 0·303in Brownings in an aft-facing Boulton Paul Type A electrically operated dorsal turret fitted to an Armstrong Whitworth Albemarle. The Albemarle's dorsal turret was offset slightly to port to allow space for a passageway through to the rear fuselage, and the fairing forward of the turret retracted automatically when the turret was trained to fire forwards. The Albemarle saw only very limited service.***

the concept of "no-allowance" or "no-deflection" shooting, suggesting it was aware of the need for heavier weapons — at least in specifying how its fighters should be armed.

INTO BATTLE

So the RAF entered the war with 0·303in-armed fighters, while German fighters were by this time armed with 20mm Oerlikon cannon. However, G.F. Wallace describes how decisions made by German aircraft designers meant that the latter's muzzle-velocity was "greatly reduced", which gave it "no greater penetration than a rifle-calibre bullet, possibly less".[18] It was definitely inferior to the 20mm Hispano cannon that the RAF was starting to introduce in 1940, albeit with very limited success at first (although the Whirlwind was declared operational in December 1940 with No 263 Sqn). Consequently, Wallace sees the RAF's eight 0·303in guns as effectively offering twice the punch of the armament fitted to the Bf 109s the Luftwaffe was operating during 1939–40.

The Air Ministry also concluded in 1940 that "the [typical] airframe can stand a very large number of strikes from all types of ammunition up to and including 20mm without failure".[19] The obvious flaw in this analysis is that it used as evidence only aircraft that had made it back to base. As an RAF Bomber Command Operational Research Section (ORS) report of November 12, 1943, notes: "Like all analyses of combats, it lacks the important details of the combats in which the fighter was successful", i.e. the bomber had failed to return, having been shot down.[20]

Another AM analysis compared the damage that might be done to airframes using either eight 0·303in guns, four 13·2mm (effectively 0·50in guns) or two 20mm cannon (the Hispano versions the AM was prototyping, not the Luftwaffe's Oerlikons) in firing trials conducted during June and November 1939 against armoured Bristol Blenheims (the loss rate of which on daylight operations during the Battle of France was high, to say the least).[21] The study concluded that the optimum "battery" would be two 20mm cannon, with eight 0·303in guns being the least effective.

The same report also goes on to state that an additional trial had been added at Sir Henry

The North American Mustang I was introduced into RAF service in early 1942 and was fitted with a mixture of 0·303in and 0·50in machine-guns; the lower engine cowling accommodated a pair of 0·50in Brownings which fired through the propeller arc, and each wing housed one 0·50in and two 0·303in machine-guns.

TAH ARCHIVE

Tizard's request, namely a "mixed battery" of 20mm cannon and 0·303in machine-guns, and that this was "substantially better" than the initial three options.[22] This was to become a standard Fighter Command weapon-fit; two 20mm cannon and four 0·303in machine-guns, along with the four-20mm cannon fit, so perhaps this trial was key to the solution Fighter Command finally went with.

BOMBER ARMAMENT

In terms of Bomber Command, as noted above, the RAF's pre-war doctrine had been that with the combination of formation flying and power-operated turrets, bombers would be able to fight their way through to their targets in daylight. The aircraft that Bomber Command started the war with — Blenheim, Fairey Battle, Handley Page Hampden, Vickers Wellington and Armstrong Whitworth Whitley — were all fitted with 0·303in guns, in power-operated turrets in the last two.

The Air Ministry Specifications that led to Bomber Command's main aircraft in the Second World War were B.12/36 for a heavy bomber, resulting in the Short Stirling, and P.13/36 for a medium bomber that led to the Handley Page Halifax and Avro Manchester (and hence ultimately the Lancaster).[23] These again specified power-operated turrets mounting 0·303in guns, and for the bulk of aircraft used by Bomber Command this is what they went to war with. However, heavy losses by the end of 1939 saw Bomber Command's faith in its ability to operate by daylight using only formation flying and power-operated turrets destroyed. The Command was thus forced to operate by night to avoid unsustainable losses.

These daylight losses were seen by some as being because the bomber's gunners were out-ranged by the cannon used by their Luftwaffe fighter adversaries. However, as with all aircraft design, compromises had had to be made; and, as noted above, the RAF had compared 0·303in and 0·50in armament during the inter-war period. For

BELOW *Along with their fighter counterparts, the RAF's bombers were also fitted with 0·303in machine-guns. After early wartime operations revealed that the Vickers Wellington had inadequate defensive firepower, the Mk III was fitted with eight 0·303in guns, the new Frazer-Nash FN20 tail turret incorporating four 0·303ins instead of just two.*

TAH ARCHIVE

"WITH EIGHT GUNS CARRIED ON A BOMBER, REPLACING ALL 0·303IN GUNS WITH 0·50IN GUNS WOULD ADD AN EXTRA 245LB THAT COULD NOT BE DEDICATED TO THE ALL-IMPORTANT BOMB LOAD . . ."

Along with the Avro Lancaster, the four-engined Handley Page Halifax was at the cutting edge of bomber technology on its introduction into RAF service in November 1940. This Halifax Mk II Series I is fitted with 0·303in guns throughout; the nose and dorsal turrets being a Boulton Paul Type C Mk I and C Mk II respectively, and the tail turret a four-gun Boulton Paul Type E.

TAH ARCHIVE

example, a 0·303in gun weighed around 22lb (10kg), while a 0·50in gun weighed up to 64lb (29kg) — with each round weighing three times that of a 0·303in round — while the 20mm cannon weighed a massive 109lb (50kg).[24] So with eight guns carried on a bomber, replacing all 0·303in guns with 0·50in guns would add an extra 245lb (110kg) that could not be dedicated to the all-important bomb load. And this is before considerations such as weight of ammunition and the potential need for stronger structures to support the weight and recoil of the larger 0·50in guns are considered. Centre of gravity (c.g.) considerations were often cited when challenging the practicality of anything larger than 0·303in guns in a rear turret. In *The Relentless Offensive: War And Bomber Command 1939–1945*, Roy Irons notes that replacing four 0·303in guns in a rear turret with two 20mm cannon would, while being heavier, have given a weight of fire three times that of the 0·303in turret, given the 20mm round was 11 times the weight of a 0·303in example.[25]

HEAVIER ARMAMENT . . .

One of the issues raised in discussions of heavier-calibre rounds was always that of accuracy; would fewer, larger rounds score as many hits, based on the ability of the average gunner? This was compensated for to some extent by the fact that a larger, higher-velocity round could be more accurate, as it would reach the target faster and suffer less from gravity-drop owing to its shorter flight time. Such a round would also likely cause much more damage than a solid 0·303in round, being explosive; so, if a hit was obtained, it was much more likely to prove fatal to the attacker.

The top brass at Bomber Command were undoubtedly dissatisfied with the punch of the 0·303in guns, with good reason. In his Despatch on War Operations, Air Chief Marshal Sir Arthur Harris, AOC-in-C Bomber Command, wrote: "I have always maintained that the defensive armament of our heavy bombers was insufficient . . . And the need for larger-calibre guns was continually stressed".[26] In *Observers and Navigators and Other Non-pilot Aircrew in the RFC, RNAS and RAF,* C.G. "Jeff" Jefford describes the advent of armour and self-sealing fuel tanks as making Luftwaffe nightfighters "relatively impervious" to Bomber Command's gunners, the latter being "seriously outgunned".[27] John Hudson, a pre-war regular who ended the war as a Master Bomber in the Path Finder Force, described 0·303in guns as "pea-shooters [with] a range of next to nothing".[28]

Harris goes on in his Despatch to explain that given AM delays and the latter's inability to produce an effective turret containing 0·50in guns, he "directly encouraged Messrs Rose Brothers of Gainsborough, [which] designed and produced a tail turret carrying two 0·50in guns" (as opposed to the standard four 0·303in guns).[29] Each turret was handmade, however, and at an AM conference in November 1944 representatives of the Ministry of Aircraft Production (MAP) stated that there was insufficient manufacturing capacity available to industrialise production and that it would take "nine months to produce tools. Furthermore, there [is] a shortage

ROSE BROS VIA VIC FLINTHAM

LEFT ***The Rose turret was designed with a great deal of input from Gp Capt A.E. Rice of Bomber Command's No 1 Group, and incorporated a pair of 0·50in machine-guns, as seen here. The Brownings were set wide apart, which not only allowed for easy servicing but also enabled the gunner to bale out directly through the generous clear-vision panel.***

of skilled labour in the turret manufacturers".[30]

The Rose turret was introduced to operational squadrons in July 1944 and eventually equipped 180 Lancasters of No 1 Group. Overall, Harris states, "those responsible for turret design and production displayed an extraordinary disregard of the requirements of the Command".[31] Roy Irons pinpoints August 15, 1940, as a key date in the Air Ministry's ability to develop effective turrets; it was on this day that the Directorate of Scientific Research, including the Directorate of Armament Development (responsible for guns and turrets), was transferred to the MAP, at which priorities were not focused on turrets and guns, development of the latter being stopped.[32]

This was at Lord Beaverbrook's direction, even though Boulton Paul had done a considerable amount of work on 0·50in and 20mm turrets for bombers by this point.[33] Wallace wrote: "It is difficult to decide overall, whether Lord Beaverbrook did more harm than good", and it certainly seems likely that if the latter had not stopped development on turrets, 0·50in and 20mm turrets would have become available to Bomber Command.[34] So Harris had been forced to take matters into his own hands to get the guns he believed were needed to defend his bombers.

. . . OR NONE AT ALL?

Was it as simple as this, though? Would 0·50in turrets have made a significant difference to Bomber Command's effectiveness or loss rates?

Part of the answer to this might have come from the Command's ORSs. However, they appear to have done little work on the merits of different types of guns, this being seen as a matter for the relevant section at the Air Ministry.[35] Randall T. Wakelam's study of operational research in Bomber Command has little to say on work done on the effectiveness of defensive armament.[36] Freeman Dyson, in recounting his time spent working in operational research at Bomber Command, recalls considering whether the bombers would be better off without gun turrets at all, since the aircraft could then fly higher and 50 m.p.h. (80km/h) faster, helping them elude Luftwaffe nightfighters.[37]

Bomber Command did indeed experiment with removing various turrets from some Halifaxes to improve performance.[38] This indicated a possible way forward — the creation of dedicated bombers for night operations which would thus only have a tail turret with heavier armament, while others would retain nose and dorsal turrets to allow daylight operations. Harris never explicitly split his Command, however, and hence never adjusted defensive armament in this way.

What is safe to say is that, based on USAAF experience, 0·50in turrets would not have enabled Bomber Command to return to daylight operations, which some believe would have made it much more accurate and effective. However, W. Hays Parks' analysis in his 1995 essay "*Precision" and "Area" Bombing: Who Did Which, And When?* does not show the USAAF as being any more accurate by day than Bomber Command was by night; this is perhaps unsurprising given European weather, so a return to daylight operations might not have significantly increased Bomber Command's impact on the war anyway.[39]

The idea of removing turrets was rejected, but a good question is whether 0·50in guns would have made a significant difference for Bomber Command, given it continued to operate by night. After all, in night operations, gun-range would be much less than it would be in daylight, so the advantage of having a longer-range weapon was reduced. Also, as we have seen above, and in other AM trials such as those mentioned by Roy Irons, the 0·50in gun was not seen as significantly better than the 0·303in gun.[40] As we have noted, the AM had concluded from its trials in the 1930s that a 0·50in turret offered little or no advantage over the 0·303in turret, the answer being a 20mm turret, although those on operational squadrons would probably have differed, seeing the 0·50in gun at least as a necessary improvement on the 0·303in gun.

ROSE BROS VIA VIC FLINTHAM

ABOVE ***The Rose Bros turret assembly shop at the company's factory at Gainsborough in Lincolnshire circa 1944. The production line incorporated eight stations, each of two stages, and work around the clock resulted in the completion of a turret in as little as 7hr. The production version was designated the Rose Type R Mk I turret.***

A 20mm turret was a much more complex proposition, and no viable turret was available before the end of the war, although after the April 1942 daylight attack on Augsburg Frazer-Nash had developed the FN79 dorsal turret with two 20mm cannon, which Harris asked be installed on No 103 Sqn's Lancasters.[41] The turret was not installed more widely owing to problems with muzzle-flash being too bright and the gyro-gunsight also being too bright for night operations (plus Harris was reluctant to create squadrons specifically for daylight operations). He did, however, accept the FN82 turret design with two 0·50in guns in March 1943, albeit as an interim measure, since it "in no way meets the requirements for the design of turrets".[42]

THE 0·50IN TURRET

As we have seen, Bomber Command did commission and install a 0·50in turret, but according to Irons this was not a complete success. An ORS paper dated March 2, 1945, found that 25 per cent fewer attacks than would have been expected were made on aircraft equipped with the Rose turret, owing to its superior visibility for the gunner, although the loss-rate for aircraft equipped with the turret was the same as for other Lancasters.[43] This was assessed as being because the Browning 0·50in machine-guns were more likely to jam; and, in the 13 engagements logged, on six occasions both guns had jammed — an echo of Fighter Command's teething troubles in introducing 20mm cannon in 1940.

The advantage brought by the Rose turret's improved visibility does raise the question of what a bomber should do if a fighter was sighted. An ORS did look at this question of whether gunners should open fire immediately or initiate an evasive corkscrew as well as potentially opening fire. From June 1943 No 5 Group implemented a policy of recommending that gunners open fire early, since it was believed that this would see the nightfighter abandon the attack rather than press it home, the bomber having revealed itself by opening fire.[44] However, work by the Command ORS suggested that in fact "too great a readiness to open fire, as in the case of No 5 Group, had increased the risk of attack by fighters".[45]

Other questions arose. In night operations, was the gunner's function actually to shoot down an attacking fighter, or to provide warning so the bomber could evade it? And to fire as much tracer as possible at the nightfighter in the hope not necessarily of destroying it, but of sufficiently shocking it to make it select another easier target? If the latter, then more rounds from a 0·303in turret might be better than fewer rounds from a 0·50in or 20mm turret that had a higher chance of damaging or destroying the nightfighter.

Finally, many of Bomber Command's issues with its turrets were as much about the field of vision they provided for gunners as about the weapons fitted in them. Reading Harris's Despatch, it is clear that he was unhappy with the field of vision

VIA VIC FLINTHAM

ABOVE ***Avro Lancaster I W4154 of No 1662 Heavy Conversion Unit, based at RAF Blyton in Lincolnshire (and thus close to the Rose factory), is seen here with a Rose tail turret in 1944. Although the latter showed much promise in increasing the defensive firepower of the RAF's bombers, only 227 examples of the twin-0·50in turret were built.***

from turrets fitted to the Command's aircraft, and Irons has more examples of Harris's trenchant correspondence on this matter. For example, on February 4, 1943, Harris wrote to the Assistant Chief of the Air Staff (Technical Requirements) describing the FN20 four-gun turret as being "80 per cent angle-iron and 20 per cent scratched Perspex"; hardly conducive to seeing a well-camouflaged nightfighter at night.[46]

Visibility was key, especially as the Luftwaffe's *Nachtjagd* began increasingly to attack from below using the oblique-upward-firing *Schräge Musik;* if a fighter was not seen as it approached from below — and it was likely the rear gunner who would see it if anyone did — then the lack of ventral armament meant the bomber's prospects were dim indeed.

In terms of why Bomber Command did not get the turrets Harris wanted, Irons suggests that, for whatever reason, those representing the Command in the many conferences where turret-design and armament were discussed and agreed did not express Harris's views forcefully enough. This was certainly the Air Ministry's view when Harris complained right up to the end of the war; the Minutes showed the Command accepting designs that Harris then described as unacceptable.[47] Having said that, Churchill's scientific adviser Frederick Lindemann was critical of the way that the Directorate of

RAF WARTIME ARMAMENT Browning machine-guns & Hispano-Suiza Mk II cannon

	Browning 0·303in	Browning M2 0·50in	Hispano-Suiza Mk II
Bore	0·303in (7·7mm)	0·50in (12·7mm)	20mm (0·78in)
Action	Recoil	Recoil	Gas-operated
Cyclic rate	1,150 rounds/min	750–850 rounds/min	650 rounds/min
Weight	21lb 14oz (9·9kg)	64lb (29kg)	109lb (49·4kg)
Muzzle velocity	2,660ft/sec (811m/sec)	2,750ft/sec (838m/sec)	2,880ft/sec (878m/sec)
Ammunition feed	Metal links	—	60-round drum
Cooling	Air	Air	Air
Rifling	5 x grooves, left-hand twist, 1 turn/10 calibres	8 x grooves, right-hand twist	Right-hand twist
Cocking	—	—	Pneumatic charger
Length	3ft 8in (1·13m)	4ft 8in (1·42m)	—

“THE RAF BYPASSED THE 0·50in MACHINE GUN TO DEVELOP THE 20mm CANNON FOR FIGHTERS, BEING ‘PRETTY CERTAIN THAT NO AIRCRAFT COULD AFFORD TO CARRY PROTECTION AGAINST A 20mm-CALIBRE SHELL’ . . .”

TAH ARCHIVE

ABOVE ***By the time Air Ministry Specification F.37/35 was issued in 1935, it had been recognised that striking power superior to the eight-gun armament specified in F.5/34 was worth investigating. This led ultimately to the Westland Whirlwind, fitted with four fixed Hispano 20mm cannon concentrated in the nose, as seen here.***

VIA VIC FLINTHAM

ABOVE ***Lancaster Mk VII NX791 of No 617 Sqn in 1945. The Mk VII was fitted with a Glenn Martin Type 250 dorsal turret armed with two 0·50in Browning machine-guns, as was the Frazer-Nash FN82 tail turret. Had the war lasted another year, it is likely the Martin 250 would have replaced the 0·303in turrets of all the RAF’s heavy bombers.***

1 Wallace, G.F., *The Guns of the Royal Air Force 1939–1945*, Harper Collins, 1972, p. 54
2 Keith, C.H., *I Hold My Aim*, Allen & Unwin, 1946, pp41–44
3 Wallace, op cit, p58
4 Keith, op cit, p49
5 Sinnott, C., *The RAF and Aircraft Design 1923-1939: Air Staff Operational Requirements*, Routledge, 2014, Chapter 5, "The Quest for Fighter Firepower", pp108–129
6 Brew, A., *Boulton Paul Aircraft,* The History Press, 2001, p66
7 "Comparative Efficiency of Calibre .30 and .50 Machine Guns", Air Attaché, British Embassy Washington DC to Director of Air Intelligence, Air Ministry, April 4, 1928, The National Archives (TNA) ref AIR 2/347
8 Ibid, Minute 7, May 21, 1928
9 Keith, op cit, p89
10 Ibid, p88
11 Ibid, p75
12 Ibid, pp78–79
13 TNA ref AIR 2/2741 [60A], Extract from Minutes
14 Sinnott, op cit p223
15 "Amended Requirements for Single-Engine, Single-Seater Day & Night Fighter", TNA ref AIR 2/2921, enc 32A
16 DCAS to CAS, November 11, 1935, TNA ref AIR 2/2821
17 "Operational Requirements", Wg Cdr R.S. Sorley, August 23, 1935, TNA ref AIR 2/2921 enc 26B
18 Wallace, op cit, p182
19 Sinnott, op cit, p224
20 Irons, R., *The Relentless Offensive: War and Bomber Command 1939–1945,* Pen & Sword, 2009, p142
21 "An analysis of the performance of a fixed-gun fighter armed with guns of different calibres, in a single home-defence combat with a twin-engined bomber", TNA ref AIR 20/12921
22 Ibid, para 5, Conclusions
23 Meekcoms, K.J. and Morgan, E.B., *The British Aircraft Specifications File*, Air-Britain, 1994, pp228–229
24 Irons, op cit, p61
25 Ibid, p62
26 ACM Harris, Sir Arthur T., *Despatch on War Operations*, Frank Cass, 1995, para 4, pp107–108
27 Wg Cdr Jefford, C.G., *Observers and Navigators and Other Non-pilot Aircrew in the RFC, RNAS and RAF*, Grub Street, 2014, p215
28 Smithies, E., *Aces, Erks and Backroom Boys: Personal Stories of Britain's Air War 1939–45*, Cassell, 2012, p132
29 Harris, op cit, para 7, p108
30 Irons, op cit, p138
31 Harris op cit, para 24, p111
32 Irons, op cit, p94
33 Brew, op cit, p95
34 Wallace, op cit, p93
35 *The Origins and Development of Operational Research in the Royal Air Force*, The Air Ministry, HMSO, 1963
36 Wakelam, R.T., *The Science of Bombing – Operational Research in RAF Bomber Command* University of Toronto Press, 2009
37 Dyson, F., *Disturbing the Universe*, Basic Books, 1979, pp25–26
38 Irons, op cit, p118
39 Hays Parks, W., *"Precision" and "Area" Bombing: Who Did Which and When?*, *Journal of Strategic Studies*, Vol 18, Issue 1, 1995
40 Irons, op cit, p71
41 Ibid, p110 and p134
42 Ibid, p131
43 Ibid, p138
44 *The Origins and Development of Operational Research in the Royal Air Force*, op cit, p65
45 Ibid
46 Irons, op cit, p128
47 Irons, p125
48 Professor Lindemann to the Air Ministry, August 22, 1940, TNA ref CA G250/1

Armament Development had stood between "the designers of armament equipment and the Service users", so presumably he would have understood Harris's frustrations and supported his direct engagement to get his 0·50in turret.[48]

CONCLUSION

In summary then, the RAF used the 0·303in machine-gun because its research in the 1930s showed the 0·50in gun offered no significant advantages. It was also looking at cannon during this period and its approach to fighter armament by no means lagged the field, and at times led it.

In terms of bomber armament the 0·303in gun was not adequate to support daylight operations — but then, neither was the 0·50in gun, as unescorted missions by the USAAF's Eighth Air Force showed. So Bomber Command was always going to have to operate at night in the absence of effective escort fighters (and why the RAF did not develop escort fighters is a discussion for another time), in which case the defence of bombers focused on, ideally, ventral and rear turrets equipped with reliable 0·50in guns, which would have been an improvement.

A range of factors appears to have stymied the development of these turrets, including, crucially, the transfer to MAP of responsibility for turrets and guns. Added to this was the reluctance of Bomber Command to allow experienced personnel to go to the MAP to help with armament design, and the inability of the Command to articulate clearly its needs to the Air Ministry and manufacturers. Whether this would have made a material difference to Bomber Command's loss rates is open to question; based on the American experience, it certainly would not have enabled it to operate by day.

ACKNOWLEDGMENTS *The Editor would like to thank Vic Flintham for his invaluable assistance with the preparation of this feature*

"Faucett"

THE COMPAÑIA DE AVIACIÓN FAUCETT STORY, 1928–99

Further to Amaru Tincopa's exploration of American Elmer "Slim" Faucett's development of Stinson bush aircraft in Peru in *TAH17,* **MAURICE WICKSTEAD** focuses on Faucett's remarkable achievements in establishing what became Peru's *de facto* national airline, from primitive bush-flying in the 1920s to its demise as a jet-equipped carrier in the 1990s

VIA AMARU TINCOPA

LEFT ***Elmer Faucett was born in Savona, New York, on March 5, 1891, and after a spell with the Curtiss company at Hammondsport, arrived in Lima, Peru, in June 1920. He is seen here, aged 30, beside a Curtiss Jenny at the Peruvian Civil Aviation School at Bellavista in early 1921. Faucett went on to become something of a national hero in Peru.***

IN THE YEARS following the First World War, the young emerging nations of South America began attracting entrepreneurs, soldiers of fortune — and their fair share of rogues and chancers — from all quarters, eager to make their fortunes from the continent's abundance of untapped natural resources. Precious metals, gemstones, minerals and oil were just some of the potential sources of riches waiting to be discovered, most of which would ultimately end up controlled by foreign interests, principally those in the USA.

As with Alaska, one of the most significant drawbacks to exploitation was the inaccessible hinterland that severely impeded the movement of heavy equipment, supplies and workers to the sources of these assets. In the case of Peru, with inadequate roads and only two railway lines, much of its potential wealth was located in the largely inaccessible mountainous region of the high Andes or the almost impenetrable jungle beyond. Along with the adventurers came a few far-sighted aviators who saw the aeroplane as the answer to these difficulties, and who made their way south to pursue their ideas. One such was Elmer James "Slim" Faucett, who in mid-1920 found himself in Peru, where he would go on to create the country's first national airline company.

BACK IN THE USA

Faucett's distinguished aviation career had begun somewhat ignominiously. When the Curtiss Aeroplane & Motor Co opened a factory near his home at Hammondsport, New York, in 1919, the teenage Faucett was hired as a mechanic, eventually rising to become head of servicing and maintenance at Roosevelt Field. After assembling a Curtiss Jenny for a pilot who failed to appear for the test flight, Faucett impetuously took the machine up himself for a 15min workout, despite never having made a solo flight before. On landing safely, he learned that he had been instantly fired for this "initiative".

While Faucett cleared his desk, a call came from head office that would be his salvation — would he accompany a shipment of aircraft to South America for the Peruvian government? Thus at the end of June 1920 Faucett travelled south to Lima. Having spent a few weeks assembling the machines, he made his second unauthorised solo flight — but this time he was subsequently hired by the Peruvian government.

Shortly after attending the Civil Aviation School at Bellavista in the Province of Callao, Faucett became the proud possessor of Peru's first commercial pilot's licence and, later, performed the nation's first ever night flight. Over the next few months he flew around the country, delivering medicines and other essentials to isolated *estancias*, delivering priests and nuns to remote missions and just about anything to anywhere an aeroplane could land.

By the summer of 1921 Faucett was ready to branch out on his own and was hired by Charles Dillon, a wealthy American contractor, to fly occasional trips in his secondhand Curtiss Oriole. Faucett subsequently persuaded Dillon to loan him the aircraft for a few days in order to try for the government prize for the first flight to Iquitos, the "capital of the Peruvian Amazon", in the north-east of the country, the only practical access to which, hitherto, was by river transport. He set off from Chiclayo on the coast north of Lima on October 5, 1922, and, having somehow negotiated the 10,000ft (3,000m)-high Paso de

OPPOSITE PAGE, TOP ***A rare Faucett label incorporating a four-engined transport superimposed over an outline of Peru. By the late 1940s the airline was operating a comprehensive domestic network with a limited fleet of Douglas aircraft, including a DC-4, as depicted in the promotional item*** **OPPOSITE PAGE, BOTTOM.** VIA DACRE WATSON

LEFT ***An early luggage label of the fledgling*** **Compañia de Aviación Faucett,** ***established in 1928, featuring a stylised illustration of the company's sole Fairchild FC-2W. Initial operations by the airline were undertaken with the FC-2W and a two-seat Curtiss Oriole biplane. In 1928 Faucett supplemented this tiny fleet with a pair of Stinson Detroiters.***

CAPT DACRE WATSON COLLECTION

Porculla through the Andes without the benefit of maps or any other navigational aids, mountain storms and a shortage of fuel forced him down on a sandbar near the mouth of the Tigre River, some 80 miles (130km) short of his destination.

On landing, the Oriole's propeller was damaged when the aircraft nosed over, and the remainder of the trip was completed courtesy of a passing river launch, before Faucett returned with a raft a week later to tow the aircraft up to Iquitos. At a stroke Faucett had reduced an arduous month-long overland journey to a matter of hours by air. After two more mishaps, however, it took him until the following July to get back to Lima, returning by the then-fastest route via the mouth of the Amazon and back through the Panama Canal and west coast; a journey of some 6,300 miles (10,100 km).

Faucett was immediately hailed as a hero and with the prize money he purchased the Oriole to start his own charter service, spending the next five years flying passengers and freight virtually anywhere that was needed. These early trips were not without hazard. On one occasion, after making a forced landing in the jungle, he spent the next 40 days hacking his way out. During another sortie, while flying Lt James Doolitle up-country, they hit a stray mule while landing in a pasture in darkness. Doolittle, later famous for his many record-setting flights and the first American bombing raid on Tokyo, was on secondment from the US Army Air Corps on a South American promotional tour to demonstrate the Curtiss O-1 Falcon and P-1 Hawk military aircraft. When not flying, Faucett enjoyed equally hazardous leisure time competing in local motorcycle and automobile races, several of which he won.

INTO BUSINESS

Early in 1928 Faucett realised his ambition to start an airline. It was a risky venture; but, aided by five plucky local investors, $40,000 in start-up capital was raised to establish *Compañia de Aviación Faucett*. On June 4, 1928, the Peruvian government granted an operating licence and Peru's first airline — only the sixth to be established in South America — was in business, the fleet comprising the Oriole and a Fairchild FC-2W.

On September 15, 1928, Faucett began regular flights over a multi-stop 477-mile (767km) coastal route north from Lima to Chiclayo. After a trip to the USA in which Faucett acquired two Stinson SM-1F Detroiter high-wing monoplanes — OA-BBB and OA-BBC — the line was soon extended further north to Talará and south to Arequipa, resulting in 242 passengers being carried and 30,000 miles (48,000km) flown during the first year of operation. The company's capital was

BELOW ***In 1934 Faucett's engineering department began work on developing a larger, stronger and easier to maintain version of the Stinson SM-6B, resulting in the Faucett F-10, of which a total of 12 was built. This head-on shot of an F-10 at the company's Santa Cruz airfield in December 1936 shows its robust wide-track undercarriage.***

CURRARINO VIA AMARU TINCOPA

VIA AMARU TINCOPA

ABOVE ***A group of ladies pose with Elmer Faucett (in cockpit) beside the first Faucett F-10, OA-BBI, fitted with a distinctive forward-raked windscreen, a design feature much in vogue in the mid-1930s; the benefits of such an arrangement have long been a subject of discussion, and probably made little or no difference to performance.***

increased to $180,000 in 1929, provided by financier Clement M. Keys, head of the giant North American Aviation conglomerate, among the subsidiaries of which was Curtiss (Curtiss-Wright from July 1929). As business boomed for Faucett, more Stinsons were bought, gradually bringing the modest fleet up to seven aircraft.

In 1929 Faucett began work on creating a modern purpose-built airport (Santa Cruz) for Lima, having previously operated from the city's racecourse. He further endeared himself to the locals by opening a school to train indigenous personnel as mechanics and technicians. Apart from its exclusively American pilots, this made the airline a largely Peruvian operation.

At the beginning of the 1930s Faucett had six Stinsons in service; the first three were SM-1Fs — OA-BBB (No 2); OA-BBC (No 3) and OA-BBD (No 4) — and the other three were Pratt & Whitney Wasp-powered SM-6Bs; OA-BBE (No 5); OA-BBF (No 6) and OA-BBH (No 8). The company also operated one Travel Air 6000B, OA-BBG (No 7).

Until 1932, apart from periodic freight charters, Faucett confined itself to its established coastal route, but in December that year an inland passenger service was initiated. This 60-mile (100km) route between Chimboté and Yungay served the highly populated Rio Santa valley, but proved unsustainable.

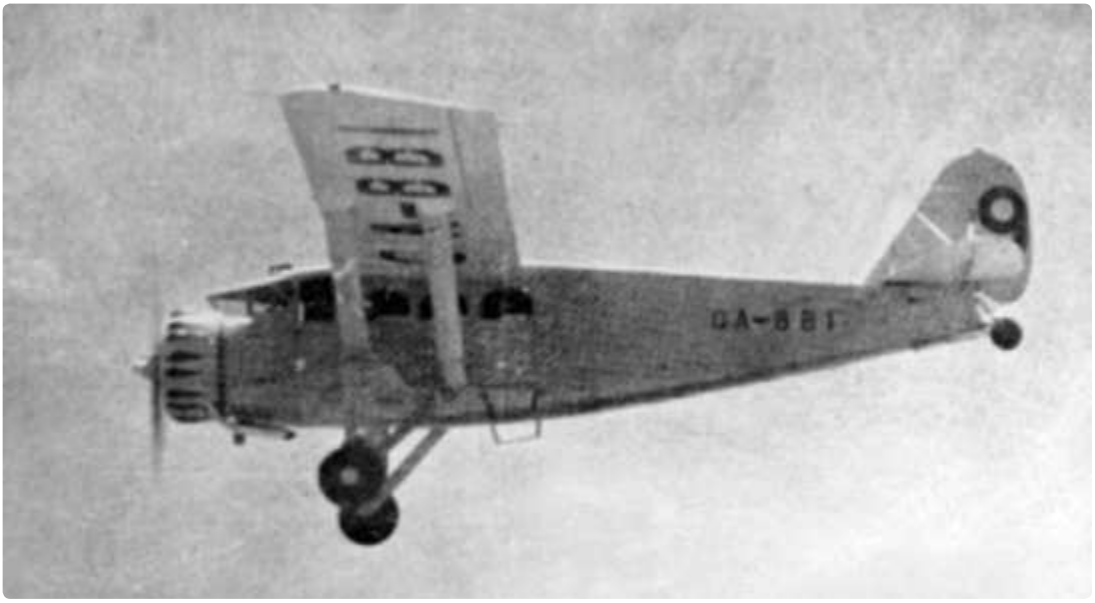
The next opportunity to expand the network eventually came in 1936, with the opening of a link between Chiclayo and Yurimaguas, some 265 miles (427km) to the east. At the latter Faucett made a connection with a branch line of Peru's state-owned *Linea Aérea Nacional* (LAN) to Iquitos via Moyobamba. With government backing, LAN had been formed in January 1930 by combining the Peruvian naval and army air services.

LOCAL CONFLICTS

Between April and July 1933 all operations were halted during a national emergency brought about by border disputes with both Colombia and Ecuador. During this period Faucett's modest fleet was pressed into service, providing logistical support to the military; much valuable experience in mountain flying and airfield construction in remote locations was gained as a result. For this and his unstinting efforts in creating an airline to serve the Peruvian people, Elmer Faucett was awarded the country's highest honour — *Orden El Sol del Perú* (The Order of the Sun).

In 1934 Clement Keys sold his holding in the airline to the Sperry Corporation, but two years later Elmer Faucett bought out the Sperry stock, making his airline effectively an entirely Peruvian company. By this time Faucett was carrying some 3,500 passengers, 61,000lb (28,000kg) of freight and mail and covering more than 240,000 miles (390,000km) annually. Clearly the airline needed better equipment to keep up with demand, but the new breed of twin-engined all-metal airliners, apart from being prohibitively expensive, were unsuited to the postage-stamp size airfields into which Faucett operated.

In mid-1934 Faucett obtained the rights to build the Stinson SM-6B locally under licence, and developed his own version, the Faucett F-10, the



VIA AMARU TINCOPA

ABOVE ***The prototype F-10, OA-BBI, was painted a vivid orange, to make it easily visible should it have to make a forced landing in the jungle, and given fleet number 9. The prototype, actually a much modified Stinson SM-6B, made its maiden flight on September 20, 1934, in the hands of the company's chief test pilot, Gale Alexander.***

first of which, OA-BBI (No 9), made its maiden flight in September that year. A total of 12 was built; the development and histories of these machines, along with Faucett's later, larger F-19, are covered comprehensively in Amaru Tincopa's article *Wings Over Peru: The Stinsons of Elmer J. Faucett* in *TAH17*.

LOCAL COMPETITION

The American-owned Pan American-Grace Airways (Panagra) operated a largely parallel route down the Peruvian coast, but until mid-1934 its mainly international and longer-distance traffic did not generally conflict with Faucett's operations, which concentrated primarily on linking local communities and some regional centres with the capital.

The situation changed in August 1934, when Panagra established a local subsidiary, *Compañia Aerovias Peruanas*. From November 1935, operating with permits inherited from the earlier absorption of Pan American-owned Peruvian Airways, twice-weekly Ford Tri-Motor services were maintained to all the coastal towns, linking up at key points served by Panagra's Panama—Buenos Aires DC-2 service. In May 1936 this network was extended inland and a month later, Aerovias Peruanas flew large quantities of mining equipment into the interior under contract.

These activities, theoretically amounting to unauthorised cabotage — defined as the right to operate sea, air, or other transport services within a particular territory (although a principle yet to be generally established at the time) — seemingly displeased the Peruvian authorities, who were keen to protect Faucett. The conflict resulted in Aerovias Peruanas being transferred to Faucett in April 1938, in exchange for a 20 per cent interest, at which stage the capital was increased to $1m.

Unsurprisingly, passenger numbers, mail and freight rose steadily until 1940, when the opening of the Peruvian section of the Pan-American

BELOW ***During March–April 1937 Lt-Col Armando Revoredo Iglesias made a much-celebrated long-distance flight from Lima to Buenos Aires in Argentina and back in F-10 OA-BBQ/No 17, seen here at Santa Cruz airfield beside other Faucett aircraft sometime after 1940, when the OB- registration prefix replaced the previous OA- prefix.***

CURRARINO VIA AMARU TINCOPA

VIA AMARU TINCOPA

ABOVE ***In March 1943 two PBY-5A Catalinas were leased to Faucett by the Rubber Development Corporation. This example (c/n 906; the other was c/n 907) was registered OB-FAA-344 on March 16, was re-registered OB-OAA-134 in November 1944 and was ultimately acquired by the*** **Cuerpo de Aviación del Perú** ***as serial 422, as seen here.***

Highway, a road network stretching from Alaska to the southernmost tip of South America, threatened to shift of some of Faucett's traditional traffic to road. This led to a temporary reduction in passenger numbers and the elimination of some of the lower-density coastal stops. By the end of 1941, much of the lost ground had been recovered, with almost 30 daily return services uplifting 16,987 passengers and 1,159,906lb (526,125kg) of mail and freight during the course of 38 million flown miles covered that year. By this time, however, all but one of Faucetts's American pilots had headed north to join the American wartime military and were replaced by local aircrew recruited from the Peruvian armed forces.

With most of the world's rubber supply cut off by Japan's relentless march across south-east Asia, the USA was forced to look elsewhere for essential supplies of latex. A rich alternative source was soon identified in the Upper Amazon region, leading to Peru becoming one of the beneficiaries of the continent's second "rubber boom".

In March 1943 Faucett was contracted by the American-owned Rubber Development Corporation to operate two Consolidated PBY-5A Catalinas converted into freighters, and over the next three years the pair hauled more than 570 tons of rubber and some 6,800 passengers. In April 1946 the Catalinas were sold to the Peruvian government for a nominal sum and the airport then under construction at Iquitos and a marine facility at Itaya were also handed over.

POST-WAR PROSPERITY

Faucett's valuable wartime assistance to the USA placed the company in a favourable position after the end of hostilities when it came to obtaining surplus military aircraft to replace its rudimentary fleet and aid future expansion. The airline soon had four Douglas C-47s and a C-54 from an early release of surplus aircraft, enabling direct flights to Iquitos in 1946 and other important domestic points thereafter.

In 1947 the airline's capital was increased once more to $1·82m, enabling the opening of new routes fanning out from Lima to every major regional centre. By 1951 the network incorporated more than 30 destinations, including a primarily tourist service to Cusco, high in the Peruvian Andes at 11,500ft (3,340m) above sea level, the capital of the ancient Inca empire and gateway to the Machu Picchu ruins. Elmer Faucett retired in August 1951, justifiably proud of having created and nurtured Peru's first truly national airline. Held in high esteem by a grateful nation, he died in April 1960 after a lifetime of adventure and aviation achievement.

Meanwhile, the state-owned LAN had developed into *Transportes Aéreos Militares* (TAM),

LEFT ***The cover of a July 1949 Faucett timetable showing the locations served by the airline's services, from Tumbes on Peru's northern Pacific coast to Iquitos, deep in the Amazon rainforest to the east, and from Tacna on Peru's border with Chile in the far south to Cusco in the Andes and the capital Lima.***

CAPT DACRE WATSON COLLECTION

and in the late 1940s into *Transportes Aéreos Nacional de Selva* (TANS). Supplementing Faucett, whose fares averaged $2.80 per 100 miles (160km), it concentrated on a different market; very basic low-fare community and social services, as well as serving military needs. Through the 1950s, Faucett's traffic figures climbed steadily to more than 100,000 passengers annually, with its modest C-47 fleet ranging over an unduplicated route network of some 4,140 miles (6,660km).

During this period a number of small domestic airlines came and went, but none posed a serious threat to Faucett's predominant position, protected by a government sensitive to public sentiment. Typical of these was *Rutas Aéreas del Perú* (RAPSA), which, with its two superannuated aircraft, a Boeing B-17 and a Fairchild C-82 Packet, lasted little more than a year, from 1955 to 1957. One brave passenger described his low-fare flight to Iquitos in RAPSA's antiquated B-17, named *El Chasqui* (The Messenger), with an American former wartime bomber pilot at the controls. Sat on a metal bucket-seat hemmed in by assorted cargo and noting the strong smell of fuel, the passenger prayed that none of his six companions smoked! To his relief, after rattling laboriously over the Andes, the B-17 landed safely.

Faucett had begun paying healthy dividends to its shareholders as early as 1933 and remained broadly profitable for the next 25 years; but, while Peru was in many respects one of the continent's more successful post-war economies, creeping inflation began to take its toll. This was reflected in the airline sector, manifesting itself in depressed earnings for Faucett — just $120,000 in 1959 — which seriously limited prospects for investing in more modern equipment. Nevertheless, in July 1960, shortly after its founder's death, Faucett took delivery of its first pressurised Douglas DC-6B, obtained from Panagra and earmarked for the Lima—Cusco route.

Three months earlier the Peruvian government

BELOW ***Built as a Douglas C-54A for the USAAF, c/n 10285 operated with*** **Flota Aérea Mercante Argentina** ***(FAMA) during 1946–50 and joined the Faucett fleet in late August 1950, re-registered OB-PBC-248. It remained with Faucett for a remarkable three decades, and is seen here at Limatambo in April 1963, before it was re-registered as OB-R-248 the following year.***

PETER KEATING © A FLYING HISTORY LTD

AUTHOR'S COLLECTION

ABOVE ***A view of the majestic Salcantay, the highest peak in the Vilcabamba mountain range, north-west of Cusco, from a port window of a Faucett airliner. Such unforgiving terrain is typical of the Peruvian landscape, and Faucett's pilots were specialists in threading their way through the rugged Andes in unpressurised piston-engined airliners.***

had granted Faucett rights to international services, eventually ratified by the USA's Civil Aeronautics Board (CAB) in October 1961. This was something of a departure for the airline, which had hitherto shown little interest in expanding beyond Peru's borders, remaining content to benefit from international-transfer traffic fed in by the long-haul and regional carriers now regularly serving Lima.

Meanwhile, American carrier Braniff, which had been flying into Lima since 1948, had obtained an 18 per cent interest in Faucett through its purchase of Panagra in January 1967. As it transpired, regular flights to Miami were not inaugurated until June 1969 and then only with a DC-4 operating a twice-weekly all-cargo service. Although Faucett conceded to the CAB's preference for jet equipment to be used over American international routes by obtaining a single Boeing 727-63, OB-R-902, via Braniff in 1967, this was actually placed on higher-density domestic routes. In 1973 Faucett's little-used passenger rights to the USA were withdrawn, and it was not until November 1997 that passenger service to Miami eventually commenced. Another 727, OB-R-1115, was acquired in June 1975 and operated for four months.

MORE COMPETITION

Despite calls for Peru to emulate its neighbours and create its own international airline, Faucett's management had remained reluctant to activate its American passenger rights, no doubt reflecting on the experiences of *Aerolineas Peruanas SA* (APSA), established in September 1956. This enterprise, largely driven by former TWA pilot C.N. Shelton, began operations in June 1957, flying a Curtiss C-46 between Santiago, Chile, and Tegucigalpa in Honduras via Lima, in association with Shelton's *Compania Ecuatoriana de Aviación* (CEA) in Chile. At the northern end this connected with yet another Shelton outfit, *Transportes Aéreos Nacionales* (TAN) of Honduras, which had obtained rights for scheduled services into Miami.

Shelton, a former barnstormer, Madame Chiang Kai-Shek's personal wartime pilot and a colourful "wheeler-dealer" on the South American airline scene, exploited this situation by running a timetabled one-stop through-service, allowing passengers to fly all the way from Lima to Miami without having to change aircraft. By undercutting International Air Transport Association (IATA) fare structures, this gave APSA an additional competitive edge over major carriers in the west-coast South American market. Shelton's scheme, while not technically illegal, soon caught the eye of the CAB, which deemed it a flagrant breach of the International Civil Aviation Organization's "Freedoms of the Air" principles and American policy guidelines.

Eventually a compromise was reached after Shelton transferred his APSA shares (33 per cent) to Peruvian nominees, and in June 1960 the CAB issued a two-year permit and APSA acquired

"HAVING DECIDED AGAINST OPENING INTERNATIONAL PASSENGER SERVICES, FAUCETT CONTINUED IN ITS TIME-HONOURED MANNER . . ."

TAH ARCHIVE

ABOVE ***Douglas C-47B c/n 32737 served with the RAF as KN368 before being one of the first examples of the type acquired by Faucett in late 1946, with which it was registered OB-PAT-200. When Peruvian civil markings were reorganised in 1964, it was re-registered OB-R-200 before being taken on strength with the Peruvian Navy in 1967.***

three DC-6Bs to service the route. Thereafter APSA expanded steadily over the next decade, eventually reaching Los Angeles, Madrid, Paris and London. But this apparent success belied the fact that by then it was deeply in debt owing to the uneconomically high lease rates for its Convair 990A jets, and it folded in May 1971 with reported debts of $22m.

A much earlier attempt at taking on Panagra's international dominance was Peruvian International Airways, one the main promoters of which was none other than Clement Keys, who had earlier funded Faucett. Established in May 1947 with DC-4s, its route — "The Airway of the Americas" — ran from Santiago north to Washington DC and New York by way of Panama and Havana, but the arrival of Panagra's pressurised DC-6s in July 1947 and Braniff's entry into the South American market a year later, only hastened Peruvian International's demise and it ceased operations in February 1949.

After a lifetime of furthering the cause of commercial aviation in Peru, Elmer Faucett died after a battle with cancer on April 10, 1960, at the age of 69. In tribute, the Avenida Elmer Faucett runs from Lima's international airport into the heart of the city.

Having decided against opening international passenger services, Faucett continued in its time-honoured manner.

FAUCETT ENTERS THE JET AGE

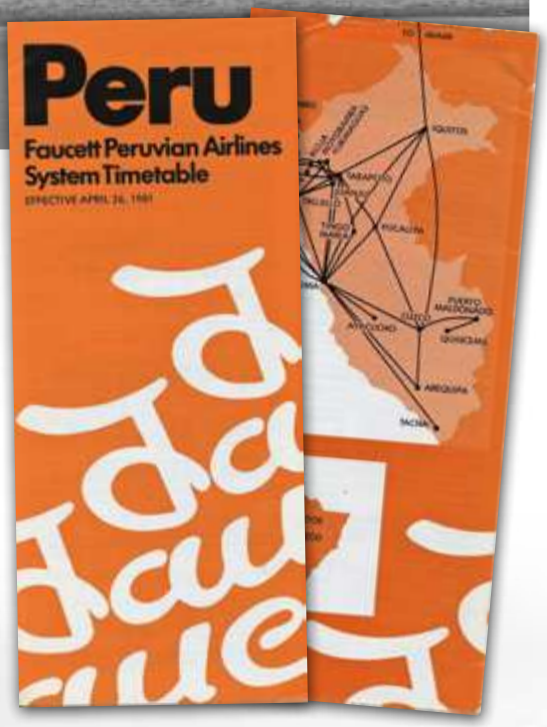
In the meantime, Faucett's surviving DC-4s and DC-6s, along with a sole C-47 and the 727, were augmented in 1971 with the ordering of two BAC One-Elevens, the first of which, OB-R-953, was delivered in July 1971, the second, OB-R-1080, in July 1974. These were employed primarily on the end-to-end coastal route and for tourist services to Cusco. This marked the beginning of a transition to an all-jet fleet which had been accomplished by 1981, when the remaining DC-4/6 aircraft were sold to *Frigorifico Reyes* in Bolivia. Another One-Eleven was leased from British Aerospace in 1977 as OB-R-1137, which was later purchased in September 1979 and re-registered OB-R-1173. The airline acquired more jets with the delivery of six Boeing 737s between 1982 and 1999.

For a decade or so from the mid-1980s, Peru was beset by social, economic and political problems. In this climate Faucett's fortunes, in the hands of several well-connected (if sometimes dubious) business and banking groups, went slowly downhill. Deep in debt and not helped by a three-week pilots' strike in November 1997, it finally went to the wall in November 1999.

Along the way the airline's various owners had included a group headed by Antonio Bentin, the uncle of British comic actor Michael Bentine, and two bankers, both later investigated for financial irregularities. The company's last owner was shipping magnate Roberto Leigh,

TAH ARCHIVE

Faucett ultimately operated a fleet of six Douglas DC-6s. This example, OB-R-750, joined the fleet in November 1964, converted into a dedicated cargo aircraft; note the lack of cabin windows and the large door in the rear fuselage for freight operations. It is seen here at Miami in April 1979.



RIGHT ***A Faucett timetable effective from April 1981, by which time the airline had fully modernised with the acquisition of an all-jet fleet.*** DAVID H. STRINGER COLLECTION

who was kidnapped for ransom by Lima's criminal underworld in 1996. This was not the airline's first brush with controversy. In 1982 one of Faucett's senior pilots, and president of its pilots' association, Victor Girao Alatrista, left the company amid allegations of involvement in drug trafficking. Escaping meaningful prosecution for years, he continued to be the subject of probes by both Peruvian and American authorities for fraud and narco-trafficking. He was later linked with Fernando Zevallos of Peru's Aero Continente, which shut down in 2004 after Zevallos was targeted by the US Drug Enforcement Agency.

By then Faucett's props had long fallen silent, but not before it could look back on a proud history that had contributed immeasurably to the development and economy of Peru.

BELOW ***In July 1971 Faucett received the first of its BAC One-Eleven Series 475s, OB-R-953, seen here. Another, OB-R-1080, arrived in 1974 and a Series 523, OB-R-1137 (later OB-R-1173), in 1977. These were used on domestic routes, often to gravel strips in mountainous terrain, for which the Series 475 had been specifically developed.***
PETER KEATING © A FLYING HISTORY LTD

VIA AUTHOR

Victor / Martel

FROM V-BOMBER TO WILD WEASEL?

The role played by the Avro Vulcan in neutralising Argentinian radar defences with Shrike anti-radiation missiles during the Falklands conflict in 1982 is well-known. Much less so is the plan hatched — and quickly abandoned — to equip a Handley Page Victor with a Martel missile to perform the same "Wild Weasel" mission. **THOMAS WITHINGTON** investigates

LEFT ***One of very few photographs taken of the "lash-up" of a Martel missile on the starboard outer wing pylon of a No 232 OCU Victor at Marham in 1982. The Argentinian invasion of the Falkland Islands in April 1982 led to the conception of the Victor as a "Wild Weasel" — the colloquial name for an aircraft specialising in suppressing enemy air defences.***

ARE YOU SITTING comfortably? Then we will begin. In order to tell the story of how the RAF's Handley Page Victor strategic bomber almost became a "Wild Weasel" anti-surface-to-air-missile platform, we must journey back to the smog-filled austerity of Britain's immediate post-war years. With its economy shattered, population exhausted and global role diminishing, there was at least some prestige on the horizon beyond the James Bond novels of Ian Fleming.

The government of Prime Minister Clement Attlee had seen the atomic bomb and liked it. The UK had a chance to join its American ally and give the Soviets pause for thought by possessing the world's most powerful weapon. Behind closed doors somewhere in Whitehall on January 8, 1947, the secret GEN-163 Cabinet Committee, comprising six ministers, with Attlee at the helm, made the decision that the UK would have a nuclear deterrent.

Ballistic missiles were still some years away. This meant "The Bomb" would need a bomber to deliver it. A year after that historic Cabinet Committee meeting, the Air Staff invited industry to tender designs for such an aircraft. It needed to have a range of 2,500 nautical miles (4,600km), a cruising altitude of 45,000ft (14,000m) and be capable of carrying a 10,000lb (4,500kg) bomb. Avro submitted its Type 698 design and Handley Page its H.P.80. The sophistication of these designs, destined to become the Vulcan and Victor respectively, meant that both would be some years from entering service. The Air Staff would therefore need a stopgap until the Avro and Handley Page designs would be ready; this arrived in the form of the Vickers Type 660, which ultimately became the Valiant.

The Valiant was the first of the RAF's "V-bombers" to enter service, No 138 Sqn at RAF Wittering becoming the air arm's first "V-Force" unit when it received its first Valiant B.1s in July 1955. The Valiant was followed into service by the Vulcan B.1 in May 1957 when No 83 Sqn was activated at Waddington. The final member of the V-Force triumvirate, the Victor B.1, entered operational service with No 10 Sqn at Cottesmore in April 1958. That the V-bombers could rain destruction of biblical proportions on to their targets in the Soviet Union, courtesy of their nuclear weapons, was in no doubt. The problem these aircraft would face was getting there intact.

SOVIET AIR DEFENCES

The vulnerability of cities to strategic bombing, as demonstrated in both the European and Pacific theatres during the Second World War, and the awe-inspiring power of *Little Boy* and *Fat Man* above the Japanese cities of Hiroshima and Nagasaki, was not lost on the Soviet leadership. Like the USA had with scientists like Wernher von Braun, the Soviets snapped up German boffins at the end of the Second World War. Matching the emerging science of rocketry with the vulnerability of Soviet cities and strategic targets to nuclear attack prompted Moscow to invest heavily in air defence.

Perhaps taking a cue from the Luftwaffe's wartime Kammhuber Line nocturnal air-defence system and the RAF's Dowding System, the Soviets had learned important air defence lessons from the recent conflict. It was not enough to have fighters, and now surface-to-air missiles (SAMs), that could intercept bombers; also needed was a state-of-the art radar system to detect and track hostile aircraft. Sector Operations Centres (SOCs) — in which the air situation in a specific

TAH ARCHIVE

ABOVE ***With its sleek shape and distinctive crescent wing, the Victor was the most advanced of the three V-Bomber designs and unsurprisingly was the last of the three to enter RAF service. The first operational bomber unit to receive the Victor B.1 was No 10 Sqn at Cottesmore, where this photograph was taken in September 1958.***

locale could be monitored via radar pictures — were vital, as were radio and telephone communications knitting the SOCs, radars, fighters and SAMs together. If the Soviets were to protect Moscow, Minsk and Magnitogorsk from *Little Boy* and *Fat Man's* descendants, the VVS (Soviet Air Force) would need an Integrated Air Defence System (IADS).

The IADS would be the preserve of the Soviet Air Defence Force (PVO). While the RAF was busy introducing its V-bombers into service, the USSR had preoccupied itself with how these threats could be shot out of the sky. In 1956 the PVO declared the S-25 Berkut (Nato reporting name SA-1 *Guild)* high-altitude long-range SAM system operational. Tasked with the defence of Moscow, the S-25 could reportedly reach a maximum altitude of 60,000ft (18,000m). It was followed in 1957 by the S-75 Dvina (SA-2 *Guideline),* which had a maximum engagement altitude of 82,000ft (25,000m) and range of 45km (28 miles). The S-75 was not restricted to defending Moscow; SAM batteries were deployed around other urban, industrial and government targets. Worryingly for the RAF, the S-75 was deployed along what the Soviets considered would be the enemy's likely bomber-ingress routes towards their targets.

For these SAM systems to be effective, and for fighter controllers in their SOCs to guide their aircraft towards hostile aircraft, radar was indispensable. Both the S-25 and S-75 were radar-based systems. The S-25 had the R-113 Kama ground-based air-surveillance radar transmitting in S-band (2·3GHz–2·5GHz/2·7GHz–3·7GHz), which had a range of 300km (190 miles). This performed the initial detection of the hostile aircraft, after which targets were handed over to the S-band B-200 fire-control (FC) radar, which managed the interception. The S-75 used the VHF P-12 (*Spoon Rest*) ground-based air-surveillance radar, which would hand off targets to the S-band SNR-75 (*Fan Song*) FC radar for the interception.

Fighter aircraft were also dependent on radar. Much like the SAM batteries, ground-based air-surveillance radars like the S-band and L-band (1·215GHz–1·4GHz) P-30 (*Big Mesh*) system, with a range of 180km (110 miles), which entered service in 1955, would perform the initial detection of hostile aircraft. Controllers would then guide fighters to their targets using ground-controlled interception (GCI) radars like the S-band P-20 (*Token*), which entered service in 1951. This had a range of 70km (45 miles), which improved as new variants were developed.

BLINDING THE ENEMY

Losses of bombers and aircrew during the Second World War brought home to the RAF just how costly flying into heavily defended airspace could be. If radar was the "all-seeing eye" of an air defence system, then there was an imperative that it must be blinded. Likewise, radio communications were the nervous system to share information on targets and the direction of the air battle. As RAF Bomber Command's No 100 Group, which had been raised in November 1943 specifically to battle Luftwaffe air defences had learned, a radar could be blinded, and the nerves paralysed through jamming.

A decade after Bomber Command had flown its

TAH ARCHIVE

ABOVE ***A Soviet S-75 Dvina (Nato reporting name SA-2* Guideline*) surface-to-air missile (SAM) mounted on a Zil-131 transporter of the East German Army during the Cold War. The S-75 was the first SAM to claim an enemy aircraft, when a Taiwanese Martin RB-57D was shot down at 66,000ft (20,000m) over Beijing on October 7, 1959.***

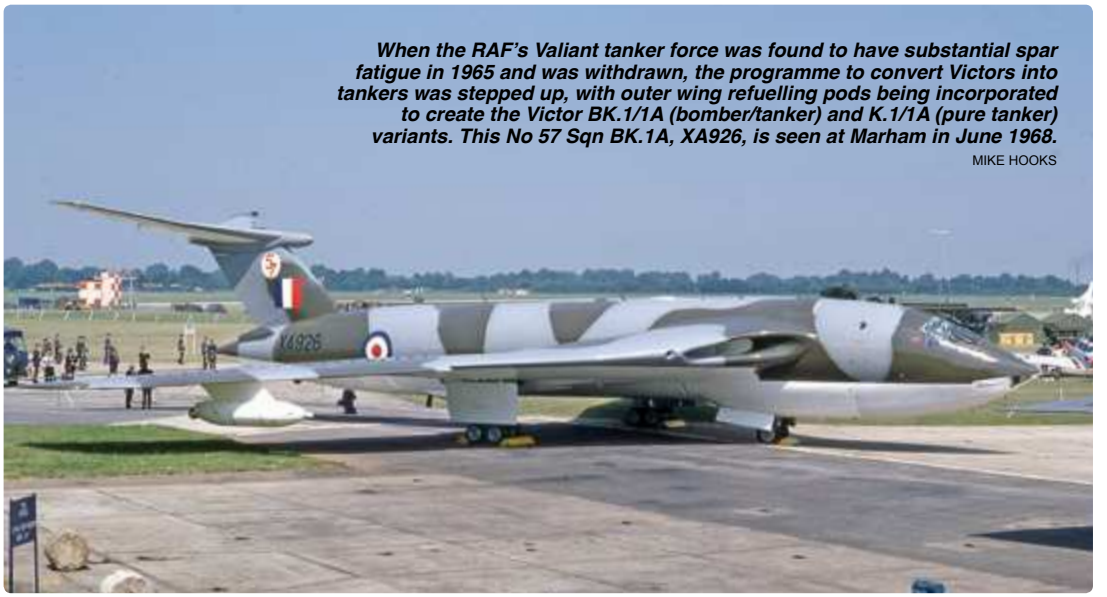
last sorties against German cities, those lessons learned had been all but forgotten. All three V-bombers, technological marvels though they were, had entered service bereft of the means to jam Soviet radars and communications. Instead, the creative use of speed and altitude was the order of the day in the hope of making the jets hard to detect and intercept.

Some in the Air Ministry saw sense, however, realising that the bombers needed equipment to detect and jam the enemy's radars and knock out communications. The Ministry subsequently stipulated that the bombers were to have electronic countermeasures (ECM) equipment fitted to engage the Soviet IADS. As the excellent *Exploit and Deny: 100 Years of Electronic Warfare in Air Operations* by Paul Moss and Steve Roberts (Selex ES, 2014) notes, the V-bombers were to be fitted with ECMs to attack ground-based air-surveillance and FC/GCI radars, radar-guided missiles and radio communications.

Work began on developing ECMs for the V-bomber fleet in December 1955 using a Valiant testbed. The work yielded a host of devices, all of which would share delightfully eccentric "rainbow" codenames. The ARI.18074 *Green Palm* was developed to jam VHF radio voice communications across frequencies of 30MHz to 300MHz; ARI.18075 *Blue Diver* was to jam VHF radars and ARI.18076 *Red Shrimp* was developed to deal with S-band FC/GCI radars. The "chaff" radar countermeasure known as *Window,* developed during the Second World War, was also to be used by the V-bombers. The latter worked by sowing thousands of metallic strips, cut to half the wavelength of the radar they were intended to jam, into the atmosphere. Radar beams would bounce off the strips and be reflected to the antenna, the strips showing up on the radar as an echo. Thousands of metallic strips would return thousands of echoes, all of which would be shown on the radar screen. In this

BELOW ***Vickers Valiant WP204 was used for trials of Avro's Blue Steel nuclear stand-off missile, the aircraft seen here with an experimental test round of the missile in its specially adapted bomb bay. The Valiant was not used operationally for Blue Steel, however, that role being allocated to the RAF's force of Vulcans and Victors.***

TAH ARCHIVE



When the RAF's Valiant tanker force was found to have substantial spar fatigue in 1965 and was withdrawn, the programme to convert Victors into tankers was stepped up, with outer wing refuelling pods being incorporated to create the Victor BK.1/1A (bomber/tanker) and K.1/1A (pure tanker) variants. This No 57 Sqn BK.1A, XA926, is seen at Marham in June 1968.
MIKE HOOKS

morass of dots, one would be the aircraft — but which one? *Window* would not make the aircraft invisible, but it would make it all but impossible to track and target it with missiles.

The jamming transmitted by *Blue Diver* and *Red Shrimp* was little changed from that performed by 100 Group during the war. So-called "barrage jamming" would be used by the V-bombers if the unthinkable happened and they were ordered to attack their targets in the Soviet Union. This was a process by which torrents of electronic noise was blasted out by the aircraft's ECMs in the hope of deluging the enemy's radars with interference, in order to prevent the latter accurately detecting and tracking an aircraft. Electronic attack would be performed across a wide band of frequencies to prevent the ground-based radars from changing their frequencies to outflank the jamming. It was crude but intended to help the aircraft press on towards their targets in the face of determined Soviet air defenders.

A switch in RAF doctrine from the high-altitude penetration of the Soviet IADS to low-level operations marked the end of the Victor as a bomber. Famously, on May 1, 1960, a Lockheed U-2 piloted by Francis Gary Powers was hit by an S-75 SAM at an altitude of 62,000ft (19,000m) near the city of Sverdlovsk (now Yekaterinburg). Clearly, altitude would no longer provide sanctuary for the RAF's V-bombers. The Victor was not designed for low-level operations and was retired from the V-Force in late 1968. It found a new role as a tanker, however, alongside a small number of Victor SR.2 reconnaissance variants.

OPERATION *CORPORATE*

On April 1, 1982, Argentina invaded the Falkland Islands, a possession of the UK in the South Atlantic. Of the 34 Victor B.2s built, 24 had been converted (some from SR.2s) into Victor K.2 tankers, with one aircraft subsequently lost in a mid-air collision over the North Sea in March 1975. At the time of the Falklands invasion the Victor tankers were the only inflight-refuelling aircraft available to the RAF.

Operation *Black Buck*, a series of long-range Offensive Counter-Air (OCA) sorties involving Vulcan B.2s attacking several targets critical to Argentinian airpower, was conceived in the immediate aftermath of the invasion. The British government gave the go-ahead on April 27. In total, seven *Black Buck* sorties were flown during April 30–June 12. Three were directed against *Fuerza Aérea Argentina* (FAéA — Argentinian Air Force) Westinghouse AN/TPS-43F S-band and Cardion Electronics AN/TPS-44 L-band

Avro Vulcan B.2 XM597 participated in the three Operation* Black Buck *sorties — Four, Five and Six — allocated to the suppression of enemy radar on the Falklands during May–June 1982, and is seen here fitted with an AGM-45A Shrike missile on its port wing pylon. Artwork by JUANITA FRANZI / AERO ILLUSTRATIONS © 2021

VIA CHRIS GIBSON

VIA AUTHOR

ABOVE ***The Oerlikon Contraves Skyguard all-weather fire-control radar unit (seen here on the left) was developed by the Swiss company in collaboration with Swedish company Ericsson in the 1970s. It was used to control the accompanying Contraves GDF 35mm anti-aircraft cannon, seen here in action on the right.***

RIGHT ***The AN/TPS-43 radar system was developed by Westinghouse and entered service in the USA in 1968. The system was deployed by the Argentinian Air Force during the Falklands conflict in 1982 and survived two of the RAF's Vulcan "Wild Weasel" sorties;*** **Black Buck Five** ***on May 31 and*** **Black Buck Six** ***on June 3.***

ground-based air-surveillance radars deployed around the Falklands capital Port Stanley. An *Ejército Argentino* (Argentinian Army) Oerlikon Skyguard X-band (8·5GHz–1·68GHz) FC radar supporting Contraves Super Fledermaus anti-aircraft artillery, deployed to bolster the island's air defences, was another target.

These radars were to be put out of action by American-designed and -built AGM-45A Shrike Anti-Radiation Missiles (ARMs) fired from the Vulcan. On May 28 Operation *Black Buck Four*, which was to be the first Shrike mission, was recalled to Wideawake airfield on Ascension Island in the South Atlantic, after problems with one of the Victor tankers. *Black Buck Five* took place on May 31. This was against an AN/TPS-43F installation, but the two missiles failed to put the radar out of action. *Black Buck Six* was undertaken three days later against the same radar. Although Vulcan pilot Sqn Ldr Neil McDougall worked hard to convince the radar operators to activate their equipment by loitering in their vicinity so that the Vulcan's missiles could detect the radar's transmissions, the Argentinian air defenders did not fall for the ruse. Instead, two Shrikes were launched against the Skyguard radar installation, destroying it and killing four of its operators.

The *Black Buck* operations, which held the record as the longest bombing raids in history until the USAF's Operation *Enduring Freedom* missions in 2001, involved a round-trip of some 7,580 miles (12,200km), not to mention an aerial-refuelling plan of fiendish complexity. Nonetheless, one largely forgotten part of this undertaking was that the Victor almost became the chosen platform for *Black Buck's* anti-radar offensive. The Victor was evaluated for this role by the RAF — but not with the AGM-45A Shrike. Instead, it was proposed that it carry the Hawker Siddeley/Matra AS-37 Martel ARM.

A VICTOR WILD WEASEL?

According to official documents, when the RAF began ruminating on the feasibility of using a V-bomber to attack OCA targets on the Falklands, "the installation of [the] AR [Anti-Radiation] Martel on the Victor was the first impromptu weapon . . . to be considered". Configuring the Victor to launch Martel required two engineering efforts; one mechanical and the other electrical. The mechanical dimension focused on equipping underwing hardpoints on the Victor with a pylon housing the Cobham ERU-120 ejector-release unit on which the missile was to be carried. The

VIA CHRIS GIBSON

ABOVE ***Weighing three times as much as the AGM-45A Shrike and with half the speed, the AS.37 Martel had much greater range and destructive power. The Anglo-French Martel — Missile Anti-Radiation, Television (referring to its two guidance options) — equipped the Armée de l'Air's Sepecat Jaguars, as seen here on the centreline pylon.***

TAH ARCHIVE

ABOVE ***In British use, the Martel was fitted to the Blackburn/Hawker Siddeley Buccaneer. This example of the latter at Hanover Air Show in 1974 carries a pair of anti-radiation Martels on its outer wing pylons and an anti-shipping television variant on its starboard inner pylon, for which the associated pod is on the port inner pylon.***

LEFT ***A Westinghouse AN/ALQ-101(V) pod attached to a port wing pylon of a Buccaneer. Rather than simply trying to overwhelm the enemy radar with "noise", this pod manipulated the transmissions from the enemy's radar-guided weapons and retransmitted them back to the source, apparently placing the podded aircraft some distance away from its actual location.*** TAH ARCHIVE

pylon would have to carry a weight of 1,200lb (546kg) and withstand the rigours of flight and the stresses of the missile's launch.

The work was shared among engineers at British Aerospace's Woodford factory near Manchester, RAF Victor specialists and the Martel Service & Support Unit (MSSU). The latter was responsible for the missile's electrical installation connecting the weapon to the aircraft's avionics. A solution was found in the electrical installation of the Martel on the RAF's Blackburn Buccaneers.

Although the engineers had proven the feasibility of installing Martel on the Victor, it was the Vulcan that emerged as the preferred platform. A comparison of the Martel fit for each bomber type noted that "both the mechanical and electrical aspects of the design and installation [are] simpler for the Vulcan than for the Victor".

Indeed, several factors were in the Vulcan's favour. In the early 1960s five Vulcan B.2s had been converted to deploy the American GAM-87 Skybolt air-launched ballistic missile. Fitted with a one-megaton nuclear warhead, the missile was to be the mainstay of the UK's air-launched nuclear deterrent, the British government having made the decision to purchase Skybolt from the USA. However, development problems led to the missile's cancellation in December 1962, which left the British without a replacement for the Avro Blue Steel air-to-surface stand-off missile, which was becoming rapidly obsolete in the face of Soviet air-defence enhancements. Blue Steel soldiered on until late 1970, when the strategic element of the British nuclear deterrent passed to the Royal Navy's submarines with Polaris.

An important legacy of the abortive Skybolt programme, however, surfaced 20 years later as the RAF prepared for Operation *Black Buck*. On the five Vulcan B.2s that had been fitted with a pylon under each wing to carry Skybolt, one pylon was free to carry Martel and the other could carry a podded ECM. The Vulcans had long been fitted with ECMs, and these had been augmented with new systems over the years. For example, the ARI.18146 *Red Light* X-band jammer was fitted to 30 of the Vulcan B.2s. However, these ECMs were feared to be ineffective against the relatively modern radars Argentina had acquired in the late 1970s and early 1980s and deployed to the Falklands.

MARTEL ON VULCAN?

A solution was found in the guise of the Westinghouse AN/ALQ-101(V)10 podded ECM. Whereas the "legacy" ECMs equipping the V-bombers largely relied on "brute-force" jamming to blind a radar, the AN/ALQ-101(V)10 was rather more sophisticated. It would sample the incoming radar signal, manipulate the signal's frequency or the radar's pulse-repetition rate (used to determine the target's movement and range) and retransmit these back to the radar to convince the radar that its target was in a different part of the sky or moving at a different velocity. This is known as "discreet jamming", as the subtle manipulation of the radar signal might not be immediately obvious to the radar operators. Barrage jamming, on the other hand, will help to obscure an aircraft, but immediately discloses to the radar operators that their systems are under attack.

A Martel pylon which would fit on the Vulcan's underwing hardpoints was developed by engineers at Woodford and RAF St Athan in Wales. The Vulcan/Martel combination then performed a test firing against a simulated radar target on the Ministry of Defence's Aberporth test range on the Welsh coast. Much as the Victor had been superseded by the Vulcan as the preferred offensive aircraft for the anti-radar dimension of *Black Buck*, Martel would similarly be replaced. The official record notes concern over the limited frequency range of the missile compared to the AGM-45A Shrike. An additional benefit of the latter was that, unlike Martel, two could be carried on one underwing pylon.

The original specification for Martel, dating back to the mid-1960s, called for the missile to engage L-band, S-band, C-band and X-band radars, although the C-band and X-band requirements

TAH ARCHIVE

ABOVE ***Buccaneer S.2 XV350 was used for extensive trials with Martel during 1969, and is seen here with three television examples, with the associated electronics pod on the starboard inner pylon. The missile was also fitted to the RAF's Jaguars and one could be fitted to the Nimrod, as well as France's Mirage III and F1 fighter-bombers.***

were later deleted. At the time, the RAF discerned that S-band and L-band radars, particularly those combined with the S-75 SAM system, were its biggest worry. Soviet C-band and X-band radars for SAM batteries were a more distant concern. The RAF concluded that Soviet radar designers would be unlikely to go down the latter path in the near term. It assessed that these radars would not begin to proliferate inside the Soviet Union and with Soviet client states until the late 1970s.

Development problems experienced in meeting the original requirements for C-band and X-band seekers prompted the RAF to confine itself to ordering the S-band and L-band Martel variants. Martel would be able to target AN/TPS-43F and AN/TPS-44 radars, but not the Skyguard.

Another factor counting against the Victor was the aircraft's importance as a tanker. Some 14 Victor K.2 tankers, almost two-thirds of the RAF's total force, were deployed to Ascension Island to support the six Vulcans to be used for *Black Buck*. Releasing just one of the Victors from its refuelling mission to launch Martel was deemed a risk to the vital refuelling plan, which was to be performed not just once, but in support of seven missions. The balance of the Victor force still had to support day-to-day missions and training in the UK. Given that aircraft can become unserviceable, or worse, be lost in accidents or to enemy action, the RAF needed all the tankers it could get to support Operation *Corporate*.

As noted, the engineers ultimately concluded that the mechanical and electrical aspects of the prospective installation of Martel presented fewer challenges on the Vulcan than on the Victor. True, the Victor tankers had hose-and-drogue refuelling pods fitted to hardpoints beneath each wing, and the few pictures in the public domain that show the Victor/Martel lash-up do seem to show the missile being affixed to these hardpoints. Nevertheless, the idea was not pressed further once it became clear that installation on the Vulcan would be less onerous.

THE WILD WEASEL THAT NEVER WAS

In conclusion, the Victor/Martel effort was not in vain, in that it provided valuable guidance for the later Vulcan/Shrike combination. The official record states that "although the installation was never completed, the lessons learned were useful in later installations", notably on the Vulcan. The Victor ultimately helped pave the way for the Vulcan's hasty redevelopment as a makeshift "Wild Weasel" air-defence platform.

ACKNOWLEDGMENTS *The Editor would like to thank Chris Gibson for his invaluable assistance with the preparation of this feature*

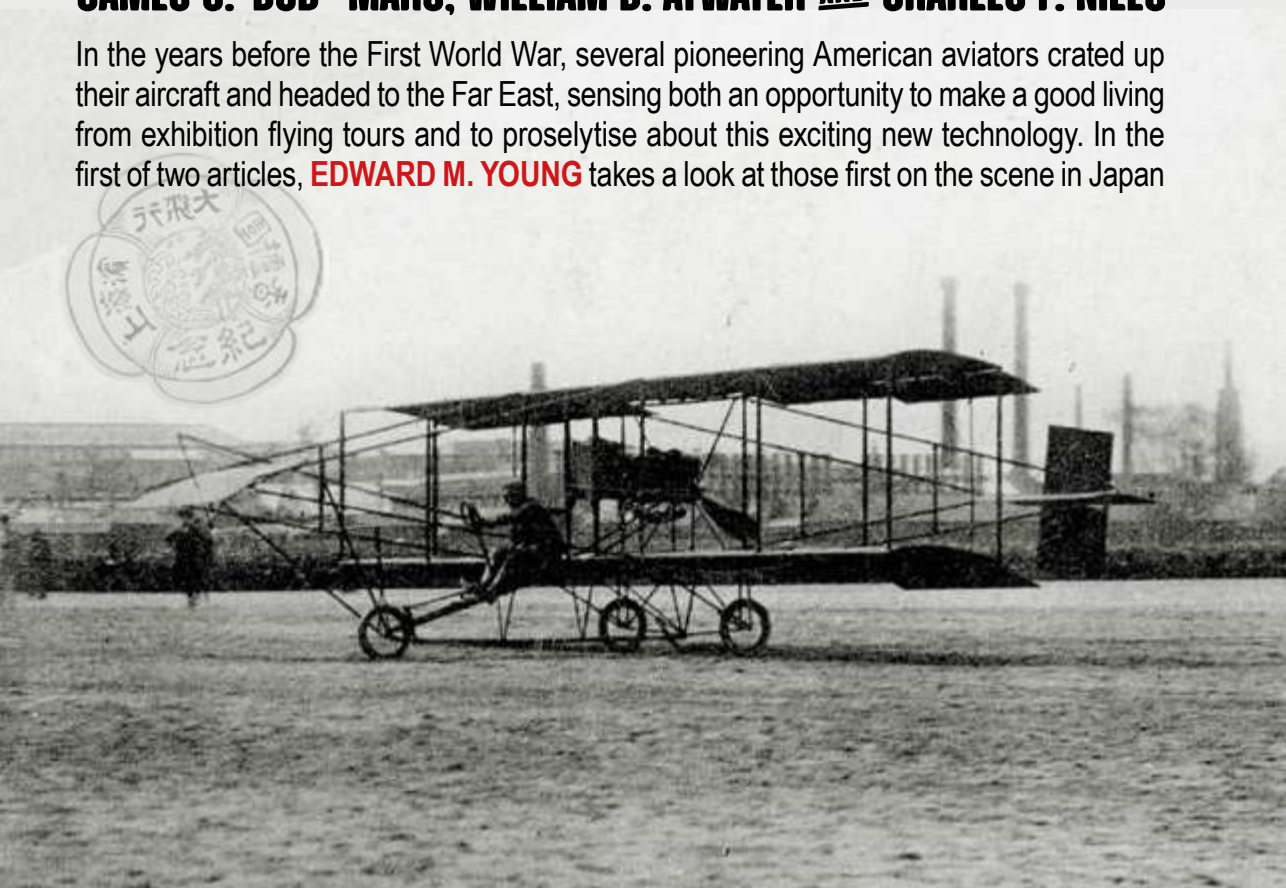
AMERICAN AVIATORS in Japan

歓迎

Part one 1911-17

JAMES C. "BUD" MARS, WILLIAM B. ATWATER AND CHARLES F. NILES

In the years before the First World War, several pioneering American aviators crated up their aircraft and headed to the Far East, sensing both an opportunity to make a good living from exhibition flying tours and to proselytise about this exciting new technology. In the first of two articles, **EDWARD M. YOUNG** takes a look at those first on the scene in Japan



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LEFT ***Thomas Scott Baldwin was born in Missouri in June 1854 and, after working on the railroads and as an acrobat in a circus, became the first American to descend by a parachute from a balloon, in January 1885, having obtained Balloon Pilot Licence No 1. After experiments with dirigibles, Baldwin developed his own aircraft, the Red Devil series of biplanes, built by Glenn Curtiss. Baldwin died in May 1923, aged 68.***

THE DAWN OF flight stimulated a fascination with the aeroplane and a desire among many to witness this latest wonder for themselves. The first air meetings attracted tens of thousands of spectators; 500,000 at the first *Grande Semaine d'Aviation* at Reims, France, in September 1909, and more than 250,000 at the Los Angeles International Aviation Meet in January 1910, for example. It did not take long for pioneer aviators in Europe and America to realise that there was money to be made in exhibition flying, such was the craze to witness the miracle of flight.

Flying meetings could attract audiences of thousands who would willingly pay to see pilots perform flights, compete in races and perform ever more daring stunts. The years immediately before the First World War saw a surge in exhibition flights across Europe and America.

During 1910 the Wright brothers and Glenn Curtiss, among others, set up exhibition companies, recruiting and training a small group of young flyers who performed across the country.[1] Several of these "daredevil birdmen", as they came to be called, found opportunities to cross the Pacific and perform their stunts in Japan, to great fanfare.

AVIATION IN JAPAN

The first aeroplane flight in Japan took place on December 19, 1910, when Imperial Japanese Army (IJA) Capt Yoshitoshi Tokugawa took off in a Farman biplane. *[We have used the Western custom of putting the family name last — Ed.]* Later that same day IJA Capt Kumazo Hino made a flight in a German Grade biplane. A crowd of 100,000 people turned out to see these first attempts. As one newspaper reporter wrote of the event: "For those who saw it, it was close to a divine miracle".[2]

Keenly aware of aeronautical developments in Europe, the IJA had sent Tokugawa to France and Hino to Germany to learn to fly and to purchase aeroplanes to bring back to Japan. This was the start of Japanese military aviation. The pair soon began making regular flights of longer duration and distance, continuing to attract large crowds of spectators. One of the IJA's goals in making these flights was to stimulate "air-mindedness" among the Japanese public to build public support for aviation.[3] In the years leading up to the USA's entry into the First World War, a small number of American aviators would contribute to fostering this fascination with aeroplanes through a series of little-known exhibition flights.

BALDWIN, MARS AND SHRIVER

In December 1910, with winter weather bringing a halt to exhibition flying in America, Capt Thomas S. Baldwin invited two fellow exhibition flyers, James C. "Bud" Mars and Tod Shriver, to join him on a tour of the Orient, where he thought there would be opportunities to earn money through flying exhibitions. Mars and Shriver had both worked previously with Baldwin, a pioneering balloonist and parachutist who had toured the Orient before. During 1890–91 he had travelled to Japan and Hong Kong, where he made balloon ascents and parachute jumps to excited crowds.[4]

In 1904 Baldwin built the USA's first powered dirigible, named *California Arrow*, using a two-cylinder engine built by Glenn Curtiss. When the aeroplane proved to be a bigger draw than the airship, the self-styled "Captain" Baldwin took up flying. He earned License No 7 from the Aero Club of America and began flying in exhibitions in 1910. For the latter, Baldwin designed his own aeroplane, built at the Curtiss Hammondsport factory and patterned after the Curtiss Model D, named Red Devil after its red silk covering.[5]

Bud Mars began his aerial carrier as a balloonist working with Baldwin. He learned to pilot dirigibles, performing in several exhibitions across America, but when Baldwin took up flying, Mars did the same. He learned to fly with Glenn Curtiss and in early 1910 received License No 11 from the Aero Club of America, joining

OPPOSITE PAGE ***Bud Mars prepares to take off from the Jōtō Parade Ground in Osaka, in a biplane based on the Curtiss Model D, for his first display in Japan on March 12, 1911. The flights made that day must have made a remarkable spectacle for the Japanese, less than three months after the first aeroplane flight in Japan.*** VIA AUTHOR

ALL IMAGES VIA AUTHOR UNLESS OTHERWISE STATED

ABOVE ***Shriver and several Japanese workers hold back the Curtiss as Mars warms up the engine of the Curtiss pusher biplane before one of his flying displays in Japan in 1911. By the end of that year, Shriver had been killed after falling 200ft (60m) from a Baldwin Red Devil biplane during an exhibition flight in Puerto Rico in December.***

Curtiss in exhibition flying. Mars made his debut at a national aviation meeting in Memphis, Tennessee, in April 1910.[6]

Over the next several months Mars participated in air meetings across the country as a member of the Curtiss team of exhibition pilots. He often encountered Baldwin at these exhibitions. Tod Shriver was another early aviator who had also formerly worked for Baldwin and for Curtiss as a mechanic, and was awarded License No 9 from the Aero Club of America.[7]

TO THE ORIENT

Mars and Shriver agreed to Baldwin's proposal to tour Asia. The trio set off from San Francisco in late December with a Curtiss Model D biplane and one of Baldwin's own Red Devil biplanes packed in wooden crates. Their initial stop was Honolulu, Hawaii, where on December 31, 1910, Mars made the first heavier-than-air flight in the Islands. From Hawaii they went to Hong Kong where they hoped to hold more flying displays, but the Hong Kong government refused to grant them permission to fly over Hong Kong Island. When no group would pay the $8,000 fee they charged for their display, they left for Manila in the Philippines, their next stop.[8]

The flyers had a contract to make daily flights during the Manila Carnival, from February 21 to March 1, 1911.[9] After a test flight, Mars made the first public aeroplane flight in the Philippines on February 21.[10] Mars would fly every evening at 1700hr, making short flights of up to 10min, and on several occasions making flights around Manila.[11] From there it was on to Japan.

Arriving in the port of Kobe, the flyers set up their aircraft at the Jōtō Parade Ground in Osaka, where the locally based newspaper *Asahi Shimbun* had contracted for three days of flights for $5,000.[12] The first flights took place on March 12, as *The Japan Times* described:

"The meeting commenced at 1330hr, favoured with beautiful weather and light winds. Mr Mars, who was to show his mastery of the air, presented himself to the eager gaze of tens of thousands of spectators who swarmed around the ground to see the much-talked-of aerial performances of the birdman. At a signal given, Mr Mars got on his favourite biplane of the Baldwin model, and after a run of about 60ft [20m], the machine left the ground quite lightly and smoothly, and gradually rose to a height of 200ft [60m]. Then the aviator, keeping this height, described a circle about 2,200ft [700m] in diameter, in a beautiful manner repeating this circular flight five times, to the great admiration of all the spectators below.

"At 1352hr a second flight was made, this time rising to a height of 2,000ft [600m]. At 1415hr a third flight was made, the biplane describing a circular five or six times very gracefully at an altitude of 500ft [150m]. This performance was greeted with almost frenzied applause."[13]

Baldwin apparently also made a flight that day.[14] Six days later Mars began another series of flights over the course of four days, using as a field the Naruo racecourse between Kobe and

James C. "Bud" Mars (left) and Tod Shriver pose beside Mars's Curtiss biplane in Japan before a flight. The arrival of the American aviators in Japan coincided with a surge in popularity of postcards, and a record of these early flying exhibitions can be traced in the postcards issued to commemorate these events. Such memorabilia served as a valuable vehicle for promoting "air-mindedness" among the Japanese public.

ABOVE ***Using a photograph of somewhat poor quality, this postcard depicts Mars flying above a Japanese crowd. It is likely that most of the spectators at these early public exhibitions had never seen an aeroplane in flight before. James Cairn "Bud" Mars (March 8, 1875–July 25, 1944) made the first flights in Hawaii, the Philippines and Korea.***

Osaka and flying in the Curtiss. He made several flights a day, circling the field and performing shallow dives, which thrilled the crowd. On the last day Mars flew out over the sea, going out two miles (3km) before returning to the racecourse. After Mars's landing, the crowd "went wild with enthusiasm", giving a standing ovation.[15]

From Osaka, Mars went on to make flights at Kyoto and Nagoya. At one of his demonstrations he threw dummy bombs from his aeroplane at targets on the ground, hitting them with apparent ease.[16] During the first week of April 1911, after Baldwin had returned to the USA, Mars and Shriver travelled to Tokyo for their final series of flights, again using a racecourse as their flying field. From today's perspective Mars's flights appear staid, consisting of simple circuits of the field — but for the many who had never seen an aeroplane in flight, they were remarkable. As *The Kobe Herald* commented after seeing a flight: "To witness yesterday's proceedings was the sight of a lifetime".[17]

THE DEDICATED AMATEUR

Baldwin, Mars and Shriver were professional flyers. William B. Atwater, the next American to fly in Japan, was a dedicated amateur. In late 1911 Atwater and his wealthy wife decided to learn to fly for the fun of it.[18] They travelled to San Diego, California, to enrol in Glenn Curtiss's aviation school at North Island, learning to fly on Curtiss hydroaeroplanes. Receiving his pilot's licence from the Aero Club of America in January 1912, Atwater and his wife decided to make a tour of the Orient, taking their aeroplanes with them. They left San Francisco for Japan on April 5, 1912, travelling on the steamer *Mongolia* to the port of Yokohama, south of Tokyo, with two Curtiss hydroaeroplanes and a standard Curtiss biplane and several anonymous mechanics.[19]

The Atwaters arrived in Japan on April 27. Nearing the port of Yokohama, Atwater asked permission to offload one of the hydroaeroplanes to make a flight over the city.[20] Somehow he managed to get his aeroplane on to the water, but the backwash from a passing ship damaged the machine and he was unable to take off.

A week later Atwater made some short flights in one of the hydroaeroplanes, on one flight covering six miles (10km) around Yokohama harbour.[21] On May 11 Atwater gave a demonstration at Yokohama for the Imperial Japanese Navy (IJN), with the Minister and Vice-Minister of the Navy Ministry present.[22] He made three flights that day, launching his hydroaeroplane from a wooden platform that led into the water. The first flight was a simple 10min circuit of the harbour, but on the second flight Atwater carried a message to a Japanese torpedo-boat, dropping it on to the ship. For his last flight, Atwater took a senior Japanese officer up as a passenger. The next day Atwater made one long flight for a group of IJA officers.

Atwater's most significant effort during his stay in Japan was in making Japan's first airmail

ABOVE ***A postcard depicting William B. Atwater taxying towards the shore in one of his Curtiss hydroaeroplanes after a flight over Yokohama harbour in May 1912. The postcard includes a reproduced signature and an inset portrait of Atwater, who apparently ran into financial trouble and bankruptcy back in the USA within a few years.***

flight, carrying mail from Tokyo to Yokohama, a distance of 18 miles (29km). His first attempt, on May 25, 1912, was a near-disaster.[23] Leaving early in the morning from Yokohama, Atwater was 10min into his flight when his engine failed. He alighted safely but ran into a small passing steamer, damaging one of the hydroaeroplane's wings. Another nearby ship quickly came and towed his aeroplane back to land.

A week later, on June 1, Atwater made another, this time successful, attempt. The flight began around 1645hr from Tokyo harbour.[24] News of the flight had spread widely and the waterfront was packed with spectators, many of whom had paid an entrance fee to a special enclosure. Atwater took off carrying a bag containing 1,000 postcards and a letter from the Mayor of Tokyo to the Mayor of Yokohama. An equally large crowd, including some 300 naval officers, awaited Atwater's arrival in Yokohama. Fireworks set off around the city announced that Atwater had departed Tokyo. At 1650hr the crowd saw a small speck emerge from the clouds. Arriving over Yokohama harbour, Atwater saw the *Mongolia* leaving for San Francisco. Atwater circled the liner then alighted on the water at 1712hr "amid deafening cheers" from the crowds lining the waterfront.[25] After 30min, during which he delivered his bag of mail to the Yokohama post office, Atwater made a return flight to Tokyo carrying a mailbag with 600 postcards for the Tokyo post office, alighting successfully where he had begun his flight.

BELOW ***An image from a postcard commemorating the occasion of the first airmail flight in Japan, showing Japanese spectators inspecting William Atwater's Curtiss hydroaeroplane on the waterfront in Yokohama. The aircraft rests on a wooden platform which allowed the machine to cross the beach and enter the water in the bay.***

ABOVE ***Charles Franklin Niles, born in 1888, learned to fly with Glenn Curtiss in 1912 and participated in a race comprising a circuit of Manhattan against five other aviators in October 1913, in which he came second. This postcard shows Niles in his 75 h.p. Curtiss Headless Model D, apparently built by the Christofferson Aircraft Co.***

A promoter engaged Atwater to make a series of flights in Osaka, which would be his last flights in Japan. Problems with his engine brought his first attempts to a halt, but after repairs he made three successful flights later in the day on June 3, rising to an altitude of 3,000ft (900m) during one flight.[26] After a pause of a week, Atwater returned to the air on June 10, making several ascents during the day. He made one flight "with his plucky wife, which deservedly called forth deafening cheers from the crowd".

Atwater and his wife continued their tour of the Orient. From Yokohama they travelled to Shanghai, where Atwater made several flights, and then on to Manila, returning to the USA in April 1913.[27]

CHARLES F. NILES

It would be more than three years before another American aviator took to the Japanese skies. The next to perform was Charles F. Niles, another professional exhibition flyer. By the time Niles arrived in Japan, many Japanese pilots had made exhibition flights around the country, but Niles's performance would be a revelation to his Japanese audience. Niles had been awarded License No 181 from the Aero Club of America in November 1912 and soon joined the Curtiss exhibition team.[28]

In late 1913, having learned to fly a Moisant-Blériot monoplane, Mars left Curtiss to join the Moisant International Aviators exhibition team.[29] Over the next several months he developed new display routines, learning to perform loops and fly inverted, becoming known as the "loop-the-loop" pilot.[30] Niles continued exhibition flying through 1914 and 1915, with a spell flying for a Mexican general. He made several flights at the 1915 Panama-Pacific International Exposition in San Francisco in August and September, on one flight making a sensational drop from 3,000ft (900m) to pull out less than 100ft (30m) above the Exposition buildings.[31]

With his contract for demonstration flights at the Exposition ending in November 1915, Niles's manager arranged for him to make exhibition flights in the Orient, beginning with Japan and later the Philippines.[32] In preparation, Niles had the Christofferson Aircraft Company in San Francisco build a special biplane for him, patterned after the Curtiss Headless Model D pusher, probably strengthened for aerobatics.[33] With the Christofferson biplane and his standard Blériot, Niles left for Japan on November 20, 1915, accompanied by his two managers, his mechanic and a translator.

After witnessing Niles's first exhibition flights on December 11, *The Japan Times* stated:

"Tokyo, and for that matter Japan, may be said to have seen flying for the first time yesterday afternoon. The capital had witnessed many flying displays but compared with what Mr Charles Niles, the famous American aviator did, all previous exhibitions were merely elementary.

ABOVE ***Another Japanese postcard relating to Charles Niles, this one showing Niles's Blériot being wheeled out, probably at the Aoyama Parade Ground in Tokyo. The Westerner directing the move, on the right, may be Niles's mechanic Frank Murray. By the time of the Japanese tour, Niles had established a reputation for daring aerobatics.***

The public was given to understand that it would be treated to sensationalism, but very few could have expected anything like the display which was given."[34]

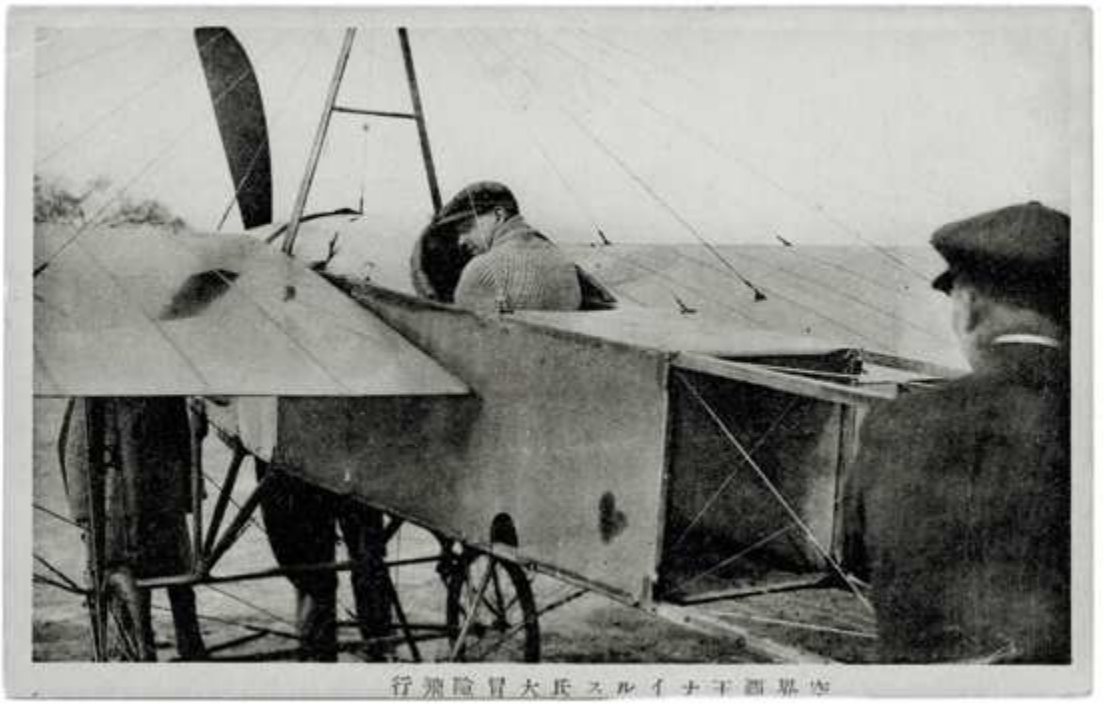
Niles and his party had arrived in Yokohama on December 7. His crated aeroplanes were shipped to Tokyo to prepare them for two days of flying scheduled for December 11–12, after which Niles was to visit several other cities.[35] On reaching Tokyo, "Do-anything Niles" — as the Japanese press dubbed him — received a welcome from 200 members of the Niles Welcome Association and from General Count Gaishi Nagaoka, the prodigiously moutsachioed president of the Japan Aeronautic Association. Niles commented that he had "never dreamed that the people of Japan took such an interest in aviation".[36] He would find out just how much interest there was a few days later.

The Aoyama Parade Ground, in the north-western section of the city near the Meiji Shrine, was the location for Niles's flying exhibitions. A crowd of several hundred thousand, the largest assembly ever at this site, packed the field. There were also hundreds of IJA and IJN officers in attendance. The Toyama Military Band played a programme of "foreign music" while the crowd waited for the flying to begin. The weather was cold, but with no wind, ideal for flying. Niles took off in his Blériot but had to land almost immediately to adjust the tail of the aeroplane. *The Japan Times* provided a graphic description of Niles's second ascent that day:

"On ascending the second time the aviator first flew upside down for about half a mile. This started the cheering of the crowd. Then, getting his machine straight again he did what is known in aviation circles as three 'falling leaves' — in other words he dropped as a leaf falls from a tree. The crowd became thrilled and cheered itself almost hoarse and waved frantically to the daring airman. Next he did two tail slides — that is, came down as if the machine were dropping tail first. Following this great display, he looped the loop no fewer than three times.

"It was more than the crowd could stand. While the machine was taking the ground the crowd beyond the perimeter simply broke loose and rushed to the vicinity of the landing . . . The aviator was at once surrounded by yelling thousands and the police were altogether powerless to control them. It was only after some desperate struggling that the aviator's assistants were able to break through and rescue the machine."[37]

It took nearly an hour for the police to restore order and clear the field of spectators. For his second flight Niles switched to the Curtiss Headless Pusher. By request he initially flew quite low to demonstrate his control over his machine, flying right over the spectators and then pulling up sharply to fly over a tree or tall object. As *The Japan Times* noted: "The confidence of the aviator was shown by the fact that at some of the most sensational moments he waved both hands together to his friends".[38] Niles then climbed to



ABOVE ***Niles in the cockpit of his Blériot preparing for a flight in Japan. Contemporary articles in the Japanese press stated that this aircraft was powered by a 50 h.p. Gnome engine, although for his exhibition flying in the USA Niles had used Gnome engines of greater power, more likely for the type of flying he would undertake.***

around 2,000ft (600m) to perform four loops, before diving down with his engine shut off. After he had landed, a car drove Niles around the field where the crowds "cheered wildly both for his skill and his daring".[39]

The next day, December 12, Niles followed the same format, flying first in the Blériot and then in the Curtiss. Niles performed loops in both aeroplanes, as well as dives and inverted flying, and with the Curtiss had a mock race with an automobile. He also apparently performed some rolls in the Blériot. The crowd this time was even bigger. Possibly as many as 300,000 people witnessing the flying were just as excited — and just as uncontrollable. Following his success in Tokyo, Niles made exhibition flights in Osaka and in Fukuoka on Kyushu. In some of these demonstration flights he used a Morane-Saulnier monoplane that the early Japanese aviator, Tsunesaburo Ogita, had brought to Japan.[40]

IMPORTANT CONTRIBUTIONS

Niles's exhibition flights in Japan made an important contribution to the development of Japanese aviation. They were a form of technology transfer, not of objects like aircraft and engines, but know-how, part of the transnational flow of aeronautical expertise that characterised the early decades of aviation.[41] The flights of Mars and Atwater had complemented the flights of the growing number of Japanese military and private flyers, but the capabilities of their aircraft limited the range of flying they could do.

Niles was not just the first aviator in Japan to perform a loop, but also the first to demonstrate an entirely new type of flying. One observer remarked that Niles's visit was "sure to mark a new era in the history of Japanese aviation".[42] "The intelligent [members of the] public", the observer commented, "are one in acknowledging the great service Mr Niles has indirectly rendered to the cause of aviation in Japan. He has shown by his extraordinary dexterity what a wide area is still left for the Japanese aviators to cultivate . . . He has also impressed upon the Japanese that aviation is not necessarily a very risky and dangerous business if attended with sufficient skill and proper attention."[43]

Prophetically, this same observer gave his opinion that the Japanese "are by their very nature vehement in the spirit of rivalry. When they have an act of superiority shown by others they cannot coolly suffer to let them go as permanently superior. They are ready to tax their capabilities to the utmost, even at the cost of their lives, to accomplish what they once determine to obtain".[44] Japanese aviation would, over the decades to come, reach parity with, and in certain fields exceed, Western accomplishments.

NEXT TIME *The author concludes his two-part series on early American aviators in Japan with a look at the Oriental flying adventures of Art Smith, Katherine Stinson and Frank Champion*

A faked image on a postcard purportedly showing Niles flying inverted in his Curtiss during one of his exhibition flights over the Aoyama Parade Ground. Perhaps unsurprisingly, Niles, in common with numerous other barnstormers of his era, met a premature death, being killed in a crash during an exhibition flight at Oshkosh, Wisconsin, on June 25, 1916.

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2 Melzer, J.P., *Wings for the Rising Sun: A Transnational History of Japanese Aviation*, (Harvard University Press, 2020), p33
3 Ibid, pp34–35, 37–38
4 Kohiri, K., Komori I. and Naito I., *Aireview's The Fifty Years of Japanese Aviation 1910–1960*, Book Two (Kantosha Co Ltd, 1961), p3; also Dunnaway, C., *Wings Over Hong Kong: An Aviation History 1891-1998*, (Pacific Century Publishers), p27
5 *Aircraft*, Vol 1, No 5 (July 1910), p183
6 *The New York Times*, April 8, 1910, p3
7 Roseberry, C.R., *Glenn Curtiss: Pioneer of Flight*, (Syracuse University Press, 1972), p186; also *The New York Times*, December 4, 1911, p1
8 Ibid, p29
9 "Mars Pleased the Japanese", *Aero,* Vol II, No 4, (April 29, 1911), p88
10 Website http://philippineairspace.blogspot.com/2011/02/centennial-of-philippines-dream-to-sky
11 "Mars Pleased the Japanese", op cit
12 *The Japan Times*, March 13, 1911; also *Flight*, April 15, 1911, p339; *Aircraft*, Vol 1, No 2 (April 1911), p47
13 *The Japan Times*, March 13, 1911, ibid
14 *The New York Times*, March 13, 1911, p1
15 "Mars Pleased the Japanese", op cit
16 *Flight*, July 22, 1911, p643
17 "Mars Pleased the Japanese", op cit
18 *Aero*, Vol III, No 8 (November 25, 1911), p157
19 Woodling, B. & Chayka, T., *The Curtiss Hydroaeroplane: The Navy's First Airplane,1911–1916*, (Schiffer Military History, 2011), p111
20 *The Japan Weekly Mail*, May 4, 1912, p535
21 *The Japan Weekly Mail*, May 11, 1912, p565
22 Supplement to *The Japan Weekly Mail*, May 18, 1912, pII
23 Supplement to *The Japan Weekly Mail*, June 1, 1912, pX
24 Supplement to *The Japan Weekly Mail*, June 8, 1912, pII
25 Ibid
26 *The Japan Weekly Mail*, June 15, 1912, p682
27 *Aircraft*, Vol 3, No 6 (August 1912), p193; also *Aero and Hydro*, Vol V, No 20 (February 15, 1913), p 365; Vol VI, No 3 (April 19, 1913), p52
28 *Aero and Hydro*, Vol VI, No 2 (April 12, 1913), p28; Vol VI, No 12 (June 21, 1913), p228
29 *Aero and Hydro*, Vol VII, No 12 (December 20, 1914), p147; Vol VIII, No 5 (May 2, 1914), p 65
30 *Aero and Hydro*, Vol VII, No 20 (February 14, 1914), p257; Vol VIII, No 19 (August 8, 1914), p237
31 *Aerial Age Weekly*, Vol II, No 3 (October 4, 1915), p57
32 *Aerial Age Weekly*, Vol II, No 10 (November 22, 1915), p224
33 *Aerial Age Weekly*, Vol II, No 3 (October 4, 1915), p57
34 *The Japan Times*, December 12, 1915, p1
35 *The Japan Times*, December 3, 1915, p1
36 *The Japan Times*, December 8, 1915, p1
37 *The Japan Times*, December 12, 1915, p1
38 Ibid
39 Ibid
40 Kohiri, K. and Naito, i., op cit, p18
41 Melzer, J.P., op cit, pp1–2.
42 Hachino, T., "American Aviator's Tricks Through Japanese Eyes", *Aerial Age Weekly*, Vol 2, No 24 (February 21, 1916), p546
43 Ibid, p554
44 Ibid

CANADA'S ICE PATROL

ICE RECONNAISSANCE DOUGLAS DC-4s, 1968–69

During a recent trawl through the *TAH* photographic archives to illustrate forthcoming articles, the Editor discovered a small collection of negatives in the Douglas files taken in Canada in the late 1960s, showing a pair of DC-4s with what appeared to be fighter-style cockpits attached to their cabin roofs. Intrigued, he set about finding out what the story was

EVERY SO OFTEN while going through the sizeable *TAH* photo archive, I come across something intriguing that sends my inner Sherlock off on an investigative trail. What is this? When was it? What was it actually for? Such was the case while undertaking one of my regular trawls of our negative collection for forthcoming articles, when I unearthed two glassine bags of 2½in-square negatives in the Douglas DC-4 file, one marked "Ice Wagon" and the other "Ice Spotter". Interesting . . .

I duly fished them out of their bags and laid them on the lightbox. A quick look through the linen tester revealed a DC-4 fitted with an additional fighter-style cockpit above its own and marked with rather long-winded titles on the fuselage: "Under Contract to Canada, Department of Transport, Meteorological Branch, Ice Reconnaissance". Even more interesting . . . So what was the story?

THE ICE OBSERVERS

In February 1969 the National Film Board of Canada published a "Photo Story" on the nation's "Airborne Guardians of the Eastern Shores", presumably having sent a film unit to cover the DoT's Ice Reconniassance team while

Douglas C-54B CF-KAD (c/n 18356) has its four Pratt & Whitney R-2000 Twin Wasp engines run up at an unidentified location. The aircraft's ice-reconnaissance work with the Canadian Department of Transport (DoT) was undertaken from Gander in Newfoundland, but there is no information on where our photographs were taken; it is more likely that it was at Downsview airport in Toronto. Note the Canadair Sabre cockpit mounted in the cockpit roof.

MIKE STROUD

it performed its work during the 1968–69 winter season. The article describes how two specially equipped four-engined long-range aircraft were being used by the Meteorological Branch of the DoT as "Ice Observers". The report reads:

"By visual observation through bubble windows, and during bad visibility by means of radar and closed-circuit electronic cameras, the team plots the extent and density of the winter ice which lies thick and thin over Canada's eastern coastal waters".

The two aircraft in question were C-54s CF-KAD (c/n 18356) and CF-KAE (c/n 36029), both operated on behalf of the DoT by Toronto-based Kenting Aviation. Originally built at the Douglas factory in Santa Monica, California, as a C-54B-10-DO, CF-KAD was was delivered to the USAAF with the serial 43-17156 in August 1944. It went on to serve with Northwest Airlines with the American civil registration N95414 and later Flying Tiger and Afghan airline Ariana, the latter for a brief period in mid-1957. It then reverted to its American civil registration before being acquired later that year by Pacific Western Airlines in Canada, where it was given the apposite registration CF-PWA. It moved on swiftly, however, and joined Canadian domestic airline Transair, which was undergoing an expansion of its fleet after the airline's formation from the merger of Central Northern Airways and Arctic Wings. How long it remained with Transair is unclear, but it was eventually sold to Kenting, probably in the early to mid-1960s.

Less appears to be known about CF-KAE, which was also built at Santa Monica, as C-54G-

NATIONAL FILM BOARD OF CANADA

ABOVE ***A member of the DoT's Meteorological Branch team uses one of the C-54s' starboard bubble windows to scan the ice fields stretching across the Gulf of St Lawrence during the winter of 1968–69. Kenting Aviation was established in 1947 as an aerial mapping and survey company using retired wartime bombers and transport aircraft specially converted for the role.***

The* TAH *lightbox with the two sets of photos of the Kenting C-54s taken in Canada in 1968. The bag containing the negatives of CF-KAE is labelled "Ice Spotter" and the other, of CF-KAD, is marked "Ice Wagon". The photos were probably taken by the Editor's father, the late Mike Stroud, one of the founding Editors of* Aircraft Illustrated, *launched that year.

NATIONAL FILM BOARD OF CANADA

ABOVE ***Meteorological Branch team members R.A. Shewchuck, E Stasyshyn and L. Goff discuss the mission during a flight in one of the C-54s.*** **BELOW** ***CF-KAE undergoes maintenance, probably in one of the hangars at Downsview. The transparent nosecone has been removed for access to the electronic navigation suite in the nose.***

MIKE STROUD

NATIONAL FILM BOARD OF CANADA

ABOVE ***One of the two Kenting C-54s undergoes preparation for its next sortie, this view again showing the Sabre cockpit to good advantage. Today falling under the remit of the Canadian Ice Service, the "ice-spotting" task has been made considerably easier with the advent of satellite imagery, but a de Havilland Canada Dash 8 is still used.***

10-DO serial 45-576, and which was delivered to the USAAF's Military Air Transport Service in August 1945. It was taken on strength with the US Coast Guard, however, with which it was operated as an R5D-4 until it was sold — minus one engine — to American company International Aerodyne Inc in mid-August 1964, registered N13060. By 1968 it had moved on again, to Kenting in Canada, which re-registered the by-now rapidly ageing C-54 as CF-KAE.

Both C-54s were outfitted by Kenting for the ice-reconnaissance role, which included the incorporation of a Canadair Sabre cockpit into the upper forward fuselage of both aircraft, presumably to provide unparallelled visibility in all directions for the most comprehensive data-gathering of information about ice patterns on Canada's rugged coastal system of islands, straits, gulfs and enormous bays.

TOP OF THE WORLD — LITERALLY

According to the National Film Board's Photo Story, the two C-54s were sent out from their base at Gander in Newfoundland to map the ice formations from the Gulf of St Lawrence up to the entrance of the Hudson Strait, with an extension to more northerly regions and Hudson Bay in the summer months. The report states:

"Costing a million dollars — a very small insurance premium to pay for the safety of

Another photo of CF-KAD having its engines run up. The proximity of civilianised former RCAF Auster AOP.6 CF-NQC lends substance to the possibility that the series of photographs was taken at Downsview, as the Auster was based there during 1962–70. MIKE STROUD

CF-KAD comes in to land on the 8,400ft (2,560m) runway at Gander having completed another successful mission. The C-54s were replaced by Lockheed 188 Electras CF-NAY and CF-NAZ, operated by Nordair Ltd of Montreal. The latter aircraft was also fitted with an observation dome similar to the Sabre cockpits fitted to the C-54s.
NATIONAL FILM BOARD OF CANADA

NATIONAL FILM BOARD OF CANADA

LEFT ***Navigator G. Bayliss takes solar observations during one of the long C-54 flights in 1968. Ten years later, sideways-looking airborne radar (SLAR) was fitted to the Electras and a de Havilland Canada Dash 7, enabling a 100km (60-mile) swath either side of the aircraft to be imaged and downloaded instantly via datalink to the icebreaker vessels below.***

winter navigation — the annual search is continued for several months as conditions warrant. From these reports navigational directives are immediately circulated to shipping and the data obtained is also added to the continuing scientific study of the problems and phenomena associated with icy seas."

This data fostered the development of more accurate ice forecasts, which improved winter navigation and increased safety for shipping.

The crews had to have an extremely high degree of training in navigation, as the team had to know its precise location for the reports to be most effective. Although the team had to be masters of the more traditional methods of navigation — sunshots etc — the two C-54s were also equipped with various electronic aids including Doppler and Decca systems. These systems proved so accurate that on one occasion one of the C-54s spotted an upturned dory fishing-boat far out at sea and reported it to the search-and-rescue services. The C-54 was asked to return to the site 30min later, and found the exact spot in short order with ease.

The C-54s continued to be used in the ice-reconnaissance role until 1972, when they were replaced by Lockheed Electras. Little more seems to be known about the two C-54s' movements thereafter, although the Sabre cockpits were probably removed once the pair had been retired from their "Ice Patrol" work; CF-KAD was re-registered as N32DR to Commercial Aircaft Inc of Yukon, Oklahoma, in January 1982. Its erstwhile partner, CF-KAE, was eventually sold to *Agence et Messageries Aeriennes du Zaïre*, with which it was registered 9Q-COF. Its official status remains "stored" in the Democratic Republic of the Congo.

So, that appears to be the story behind this small but intriguing selection of photographs, probably taken by my late father, Mike Stroud, during a visit to North America in 1968. Happily, he had his Voigtländer Vito B camera with him and dozens of rolls of film — including several boxes' worth of Kodachrome; time to get the lightbox out again . . . **NICK STROUD**

ARMCHAIR AVIATION

We take a look at what's available for the aviation history enthusiast in the world of books and other literature, from hot-off-the-press publications to reissued classics

Airpower Over Gallipoli 1915–1916

By Sterling Michael Pavelec; Naval Institute Press, 291 Wood Road, Annapolis, Maryland 21402, USA; 6in x 9in (155mm x 231mm); hardback; 240 pages, illustrated; £38.50. ISBN 978-1-612510-23-1

GALLIPOLI CONJURES REFLECTIONS on the heroism of Commonwealth forces under futile conditions and the temporary downfall of First Lord of the Admiralty Winston Churchill. For all but a select few enthusiasts and researchers, the notion of air power during the Gallipoli campaign remains an unknown equation. Sterling Pavelec offers a fine corrective with this volume, a nicely accessible work suitable for lay readers and specialists alike.

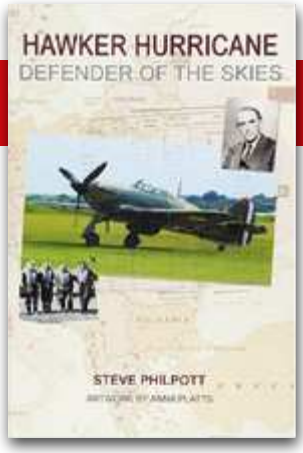
The book's nine chapters cover the background of early military air power, a chronological summary of the role of air power and its relationship to military action on the ground and sea in the region, and lessons learned. Three appendices provide excellent historiographic content to accompany the endnotes and bibliography. There are 17 monochrome images, an essential map and an index.

Pavelec advances the sustainable notion that air power played a "significant role in the campaign, even if it was not enough to turn the tide". More significantly, he argues that "air power over Gallipoli marked the expansion of joint operations . . . even if they didn't realize it at the time". Herein lies the challenge to the book's success.

The author adroitly shows that air power at Gallipoli was clearly well intended, and was undertaken with regularity and even heroics (one British pilot was awarded the Victoria Cross for rescuing a downed flyer in hostile territory). At the heart of the book, however, are the many contradictions in the role of air power throughout the campaign. Aerial spotters, for example, "could have assisted" in artillery targeting, but the lack of air-to-ground radio communications prevented co-ordination. Similarly, Turkish forces were reluctant to expose mobile batteries to aerial detection, so air power acted as a deterrent force (exactly how this was achieved remains elusive given the lack of requisite air-to-ground communications). Moreover, the lack of strategic co-ordination to guide the use of air power failed to show precisely how it could benefit ground or sea operations, and both sides were "plagued by a lack of co-ordination . . . as air power was not effectively integrated into operational planning".

It is difficult to see how this contradictory evidence supports Pavelec's claims about air power at Gallipoli as the progenitor of modern joint aerial warfare. A machine-gun attack on a German submarine is labelled as the birth of anti-submarine warfare. A planned mission to bomb Istanbul, "leading to the strategic outcome of knocking the Ottomans out of the war", was not completed, and the lone aircraft dropped its bomb on a Turkish camp. The author asserts that this event "opened another new chapter in the history of aerial warfare and [the crew was] successful in their attempt, even if it was not the intent of the mission". Subsequent bombing missions "were not co-ordinated . . . [and] indicative of the lack of joint planning". Pavalec adds that "no-one really understood the value of the air weapon or its importance to modern warfare". As the British naval commander Alexander Ramsey complained, "I don't see what you're making such a fuss about, your rotten old aeroplanes will be no bloody good anyway". Even the author is ambivalent about his arguments, saying that Gallipoli "was the birth of joint warfare . . . even though the combined air, land and sea campaign ultimately failed", and that the Allies were not equal to the task of combining the three components in a coherent battle plan.

This is an excellent narrative history that adds to our understanding of the campaign. Readers may not find it altogether persuasive in its analytic approach, however, that Gallipoli



"gave birth to the concept of joint operations [especially as] neither Allied nor Turkish air power changed the course of the fight."

ROBERT S. HOPKINS III

Hawker Hurricane — Defender of the Skies

By Steve Philpott, artwork by Anna Platts; Melrose Books (since defunct), available from the author at 19 Andrews Close, Epsom, Surrey KT17 4EX, e-mail stphphlptt@aol.com; 6¼in x 9¼in (159mm x 235mm); softback; 286 pages, illustrated; £19.99. ISBN 978-1-912026-45-6

THE AUTHOR OF this thorough history of the Hurricane, a former British Aerospace employee at Hawker's factory at Kingston, had long believed that the undoubted importance of the Spitfire in the Second World War had cast an unfairly long shadow over its equally vital Hawker counterpart, and so decided to do something about it. Some 15 years of research later, in 2018 he published this book, in which he compares the combat successes of the two types.

The book does more than just that, however. It starts with a concise but detailed and informative account of the origins, design and development of the Hurricane, followed by the production history of the aircraft, built by Hawker at Brooklands and Langley, Gloster and the Austin Motor Co elsewhere in England and overseas in Canada, Belgium and Yugoslavia.

Next comes the core of the book, in which the author examines the losses and victories of the Hurricane throughout the 33 campaigns in which it participated, from the "Phoney War" to Yugoslavia. The type's exploits with the RAF and Fleet Air Arm are described on a day-by-day basis, often with quotations from squadrons' operations record books and pilots' logbooks. For the aircraft in foreign service — Belgian, Finnish, Romanian, Yugoslav and Soviet — the coverage is less detailed owing to the scarcity of information available, but no less interesting.

The book concludes with the author's analysis and comparison of the operational records of the Spitfire and Hurricane, summarised in an appendix. There are many rare — and some well-known — photographs to accompany the text, as well as numerous colour campaign maps. *Hawker Hurricane — Defender of the Skies* is a thoroughly researched, well-produced book on good-quality heavyweight paper written by a passionate defender of the Hurricane.

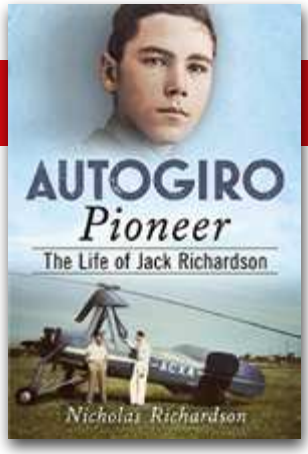
CHRIS FARARA

Britain's Glorious Aircraft Industry: 100 Years of Success, Setback & Change

By J. Paul Hodgson; Air World (an imprint of Pen & Sword), 47 Church St, Barnsley, South Yorkshire S70 2AS; 6¼in x 9¼in (159mm x 235mm); hardback; 481 pages, illustrated; £30. ISBN 978-1-526774-66-8

IF YOU ARE looking for a generously sized single volume on the UK aircraft industry, this is a pretty good start. The author rose through the ranks of that industry as an aeronautical engineer to become an aircraft designer of some note with BAE Systems, and this is clearly a labour of love which benefits from both his expertise and his personal experience.

Starting with Sir George Cayley's pioneering work on aerodynamics and experimental gliders, we ultimately end up in the age of globalisation and the creation of BAE Systems. Along the way we follow the emergence of an aircraft industry and its contribution to two world wars, and notably lots of post-1945 turbulence in five of the chapters (of which there are 11) — a fair comment on the vicissitudes of the 1950s, 1960s and 1970s! The author also provides some 14 appendices citing a number of key documents, as well as a complete inventory of British aircraft from 1900 to 2019.



The detailed chapters exploring the origins of an industry, the difficult inter-war years and the genuinely "glorious years" of the Second World War are especially interesting. He does not overlook the operational environment of both civil and military aircraft — a useful context bringing out their design strengths and weaknesses. As in later chapters, the author presents a series of brief type-histories describing the key wartime products. This approach makes for a very good reference book, but does tend to break up the narrative, and makes the remainder of the book harder to follow than it should have been. A similar approach detailing individual aircraft companies also adds to the encyclopædic value of the book, but again it underlines the somewhat episodic structure of the narrative.

The author provides an impressive survey of the British aircraft/aerospace industry and its products, although its substantive weakness is the political context, which is well described in outline, but is lost in the welter of technical and industrial detail. This weakness becomes more pronounced in the chapters on the collaborative years, where crucial linkages between the politics of the various projects are lost in the detail. There is a chapter considering some of the economic aspects of development and production, but this is not the author's strongest suit. For example, a section on the USA-European Union subsidy dispute — while not inaccurate — adds little to what is a British history. A more detailed analysis of the UK government's repayable "launch aid" system supporting civil development might have been more appropriate. However, his evaluation of the various successes and failures of the 100-plus years is fair and reasonable.

I do have one major criticism: where is Rolls-Royce and especially its crisis years of 1967–76? Its role in shaping government policy towards a raft of collaborative international projects in the 1960s and the impact of bankruptcy really should have had more attention. And one last technical gripe: for such a detailed study, we really need a subject index. These points aside, this is a very good study of a complicated history; and, whatever its detailed weaknesses, this is a valuable contribution to the story of UK aerospace.

PROFESSOR KEITH HAYWARD FRAeS

Autogiro Pioneer: The Life of Jack Richardson

By Nicholas Richardson; Fonthill Media; Millview, Toadsmoor Road, Stroud, Glos GL5 2TB; 6½in x 9½in (165mm x 240mm); hardback; 192 pages, illustrated; £25. ISBN 978-1-781557-42-6

BASED ON MANUSCRIPT notes and transcripts of tape recordings which have been edited by his son Nicholas, these are the posthumous informal anecdotal memoirs — supported by 132 detailed concluding footnotes — of Jack Richardson (1899–1987) who in 1944 qualified as the first helicopter pilot in the British Army.

An only child of parents who themselves came from large families (though no family tree is included, which would have been helpful to explain the myriad of relations who are mentioned in the opening chapter), Richardson, aged 17½, was to appreciate the discipline instilled at the Royal Military College at Sandhurst. His first regimental posting was in Germany just after the First World War had ended; later he served in Ireland during the Irish War of Independence. Leaving the Army aged 22 he then emigrated to Natal in South Africa, where he managed an orange farm bordering Zululand on the south side of the Murray River, where he stayed until Christmas 1929.

In what effectively is a family history (underlined by the detailed appendices recording further background notes to the

Flyleaves / Classic aviation books revisited

The Wild Blue Yonder: The Picador Book of Aviation. Edited by Graham Coster; Picador, 1997; 5½in x 8¾in (140mm x 220mm); hardback; 280 pages; around £3–£10

PROMISING "THE VERY best writing about flight, in all aspects", this anthology of 44 short extracts focuses on the aeroplane's impact, both historically and culturally, during the 20th Century, the Editor's interesting introduction surveying the aeronautical contributions of major writers. Beginning with the opening pages of H.G. Wells's *The War in the Air* (1908), included are a number of notable extracts from autobiographies (including Cecil Lewis, Hanna Reitsch, Antoine de Saint-Exupéry, Guy Gibson and Chuck Yeager among others) and journalists (G.L. Steer describing the aerial assault of Guernica, Martha Gellhorn on P-38 nightfighters, Tom Wolfe on "The Right Stuff", Stanley Williamson on the Munich Air Disaster and Nicholas Tomalin's Vietnam War close-up of Gen James Hollingsworth — characterised as Lt-Col Bill Kilgore in *Apocalypse Now).* Mixed with extracts from *Catch 22*, *Dr Strangelove*, *The Bermuda Triangle*, a Biggles adventure and aviation verse (Yeats and Spender among others), the dangers of flight are underlined throughout — as Guy Gibson notes, "in flying, you are either lucky or you aren't". The concluding observations on modern air travel are unsurprisingly rather tame by comparison. **BRIAN RIDDLE (former Chief Librarian, Royal Aeronautical Society)**

Richardson and Bishop sides of the family), the main interest of the book for the aviation historian unfolds in its second half, contained within Chapters 10–13 and 16–20. On his return from Natal working as a London News Agency photographer in 1931, Richardson first saw a Cierva Autogiro and was so impressed that he used his family connections to be employed by the Cierva Company at Hanworth. As a trainee pilot he studied on a C.19 alongside F. J. "Jeep" Cable under the supervision of Alan Marsh and R.A.C. "Reggie" Brie. Thereafter he became a company pilot, delivering Autogiros to France, Germany, Spain and Switzerland, spending the winter months continuing the family tradition of Alpine skiing. Indeed, it was a chance skiing encounter with an old military colleague that led to Richardson's recommissioning as an Army reservist in April 1939.

After serving in France in 1940 with the Queen's Ninth Royal Lancers, he trained to become an Air Liaison Officer acting between the Army (which was developing its fleet of aircraft) and the RAF (which had its own autogyro squadron for radar calibration, No 529, under Alan Marsh). In 1943 Richardson joined a group of RAF/Navy personnel training as helicopter pilots at the US Coast Guard school at Floyd Bennett Field in Brooklyn — gaining his "wings" on April 11, 1944 — while also reviewing the fast-growing helicopter industry in America and the helicopter's military potential. Thereafter his unique experience and knowledge led him to become the Army Advisor to the Director of Military Aircraft Research & Development, reviewing emerging British helicopter designs. He eventually left the Army in 1954, having effectively stopped flying following the deaths of Marsh and Cable in the Cierva Air Horse crash of June 13, 1950 *[as covered in* Tuesday the 13th *in* TAH32 *— Ed.]*.

The final eight years of his career — during which he worked as the London manager for Westland (overseeing the development of Battersea heliport, which he had originally conceived) and Chairman of the Helicopter Association of Great Britain — are summarised in little more than three pages, which is a shame as this was an active period of helicopter development in Britain also involving Bristol, Fairey and Saunders-Roe before rotorcraft development was centralised at Westland.

In the preface the author admits that his father's aviation career "will most probably be the main points of interest in his memoirs for some readers", and one wishes more pages were devoted to it, as few personal recollections of early helicopter development in Britain survive.

BRIAN RIDDLE

The Habsburgs' Wings 1914, Volume 1

By Andrzej Olejko; Kagero Publishing, available in the UK from Casemate UK, The Old Music Hall, 106-108 Cowley Road, Oxford OX4 1JE (www.casematepublishing.co.uk); 6¾in x 9¾in (171mm x 248mm); hardback; 202 pages, illustrated; £19.99. ISBN 978-1-61200-395-5

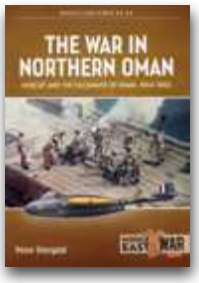
AUSTRO-HUNGARIAN aviation in the first campaigns of the Great War is the theme of this initial volume of what promises to be impressive coverage of Austro-Hungarian participation in the First World War.

This volume has only two chapters. The first covers the birth of the Air Force, and the second presents the order of battle of military aviation in 1914. However, pages 93 to 154 consist entirely of endnotes in small print which add considerable detail to the main text. There are also three 16-page glossy-paper picture sections containing a large collection of images with informative captions. Surprisingly for such a volume, an index is lacking. This is one for the specialists, but a good one.

PHILIP JARRETT

BOOKS IN BRIEF

A quick round-up of what else is currently available for the aviation history enthusiast



THE WAR IN NORTHERN OMAN
Peter Shergold
Helion & Co; ISBN 978-1-913336-33-2; £16.95

ALTHOUGH NOT specifically an aviation-oriented book, the 34th in Helion's *Middle East@War* series of 8¼in x 11½in softbacks provides a solid background for understanding the various 20th-century conflicts in this obscure but fascinating hotspot. The author, who spent time in Oman as a Loan Officer to the Sultan's Armed Forces, presents a fine survey of the events in the country during 1954–62. It includes the use of RAF Venoms, Shackletons and Canberras, as well as the formation of the Sultan of Oman's Air Force in 1959, although we were surprised to find no mention of Wg Cdr Barry Atkinson, who played such a seminal part in establishing the latter. **NS**

MACH 2: FLYING THE F-104 STARFIGHTER
Rolf Stünkel
Tredition GmbH; ISBN 978-3-471303-2-6; €15.99

IN THIS ENTERTAINING self-published 5¾in x 8½in softback (also available in hardback), former German Navy Lockheed F-104G pilot Rolf Stünkel traces his military flying career, from basic flight training in Piaggio P.149s in 1976 through to his retirement as a Tornado instructor pilot in 1989. As per the title, however, the book focuses on his time flying his beloved Starfighter, often at terrifyingly low level around the Baltic at the height of the Cold War. The lively and informative text is illustrated with many of the author's own photographs, reproduced rather flat on the uncoated paper. The narrative is divided into 13 chapters, covering training in the USA, conversion to the F-104G and on to operational flying. There are also reminiscences from colleagues, and even an East German MiG-21 pilot. A well-rendered memoir. **NS**

CLASSIC GATWICK JETLINERS
Tom Singfield
The History Press; ISBN 978-0-750994-24-8; £20

WHEN WE REVIEWED the author's *Classic Gatwick Propliners* in *TAH27*, we asked for a jetliner sequel — and we're delighted to see that he's obliged with an equally splendid volume on jet-powered civil aircraft at London's second airport. Using the same 9½in x 9in square format, this is another glorious selection of photographs, all colour, spanning the 1960s through the 1970s — ah, those Spantax Coronados! — to the 1980s. Wonderful stuff, with good notes too. **NS**

PROPLINER 2021 ANNUAL
Tony Merton Jones, Ed.
Propliner Aviation Magazine/ www.propliner.co.uk; no ISBN; £12 inc p&p in UK

PUBLISHED AS an annual since 2016, following its three-decade incarnation as a quarterly, *Propliner* is always a welcome and cherished arrival for enthusiasts of propeller-driven transport aircraft. The latest offering is a 160-page A4-format feast of 21 feature articles encompassing Silver City Airways, Avro Yorks at Shannon, Lockheed Electra flights with Reeve Aleutian Airways, post-war French independent airlines, Fokker Friendships, Air Ceylon, Bristol Freighters in New Zealand, and many other subjects. Also included are roundups of propliner news worldwide, plus reader responses. **MO**

TAC IN THE 1980s
Adrian Symonds
Amberley Publications; ISBN 978-1-445698-58-8; £15.99

THERE IS POTENTIALLY a good story here, but unfortunately that potential is not realised. Instead, the reader is presented with an impenetrable mass of data and acronyms — and no index. Lost amid the chaos are unit details, aircraft characteristics, weapons-systems notes and brief accounts of the odd operational deployment. Many of the illustrations, all sourced from the USA's National Archives & Records Administration, are printed too small and there is duplication of subject; in this case fewer would have been better. The author has worked hard at data collection and would have benefited from guidance on putting it into shape. Opportunity wasted! **VIC FLINTHAM**

NACHTJÄGER: LUFTWAFFE NIGHT FIGHTER UNITS 1939–1945
David P. Williams
Crécy Publishing; ISBN 978-1-90653-756-2; £25

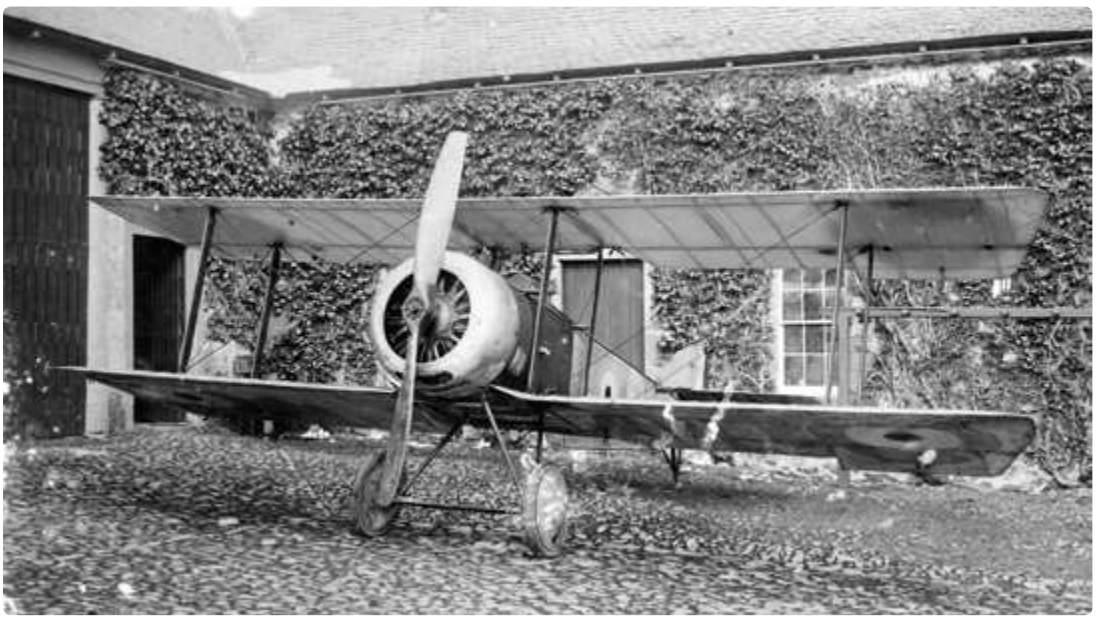
ORIGINALLY CREATED in two volumes by Chevron in 2005 and published by Ian Allan, this long out-of-print *Classic Colours* reference work makes a welcome return in this new single-volume hardback compendium. Age has not wearied it: it provides a compelling and authoritative history, profusely illustrated with more than 400 photographs and 30 colour profiles. Substantial sidebars offer biographies of, and first-hand recollections from, personnel involved. **MO**

Lost & Found

***PHILIP JARRETT** explores the lesser-known corners of aviation history, discovering little-known images and rediscovering long-lost details of aircraft, people and events. This time he asks for information about a Skegness joyrider and an anonymous Beardmore W.B.III*

ON THIS PAGE in *TAH22* I featured a Sopwith Dragon serving as a photographer's seaside prop in the 1920s, in the hope that someone might be able to provide further information. Unfortunately it drew no responses, but a few months ago I acquired another shot of it (**RIGHT**) which adds a mite to our knowledge. It is not the best of images, and has its blemishes, but it shows the other side of the fuselage, and an inscription is visible and partly legible. I believe it reads: "The Skegness Skylark", so now we know where it was, but further information is still sought.

The other photograph seen here (**BELOW**) depicts a Beardmore W.B.III, the unstaggered folding-wing version of the Sopwith Pup. This photo is stuck incongruously and uncaptioned in the back of an album mainly featuring pre-First World War aeroplanes. The album's original owner was pioneer pilot John Roderick Charles Herbert Spottiswoode, who served in the Royal Naval Air Service during the First World War. The photo shows the W.B.III in what appears to be the courtyard of a private property, a strange location for a military aeroplane, which leads me to wonder whether, in the early post-war years, Spottiswoode acquired one of the numerous examples that went straight into storage, intending to use it as his personal runabout. However, there appears to be no record of a W.B.III going on to the civil register.



Monsieur Delprat's FLYING SUMMERHOUSE

In the early 1900s a Frenchman living in north London took the concept of "moving house" to its literal conclusion with his development of a wildly ambitious "air ship" — essentially a large building with wings and a 100 h.p. engine — which he proposed would be able to carry 200 people through the air at 60 m.p.h. **PHILIP JARRETT** traces its predictable fate

EARLY IN 1905 the wealthy British aviation patron Patrick Y. Alexander received an appeal for funding for an extraordinary project. It came in the form of a letter dated January 19 from a Frenchman named André Delprat, who hailed from Paris but was writing from his "Alexandra Park Aviation Works", which had its offices at 77 Duke's Avenue, Muswell Hill, facing Alexandra Palace in north London. In the letter, translated by K. Marson in Gordon Cullingham's *Patrick Y. Alexander 1867–1943: Patron and Pioneer of Aeronautics* (Cross Manufacturing Co, 1984), Delprat wrote, in French:

"Sir,

Please permit me to call upon your love of the sciences and in particular all that concerns industrial air navigation to beg your acceptance of the transfer of my patents to aviation, which I am disposed to offer on the most reasonable terms, patents which I guarantee to you absolutely cover the complete answer to the problem of flight.

At Alexandra Palace I have started the construction of a flying-machine consisting of the following parameters:

The construction is 20m [65ft 7½in] long, 4m [13ft 1½in] wide and 6m [19ft 8¼in] high. It has eight wings to climb with and to keep it in the air, four for the propulsion itself. These wings are 15m [49ft 2½in] long and 2m [6ft 6¾in] wide. The assembly has 32m [104ft 12in] of spread. It is made in three layers and will be able to transport 200 people at 60 m.p.h. (100km/h).

The engine is around 100 h.p. It will cost at the most £2,000, everything included. It is half-built and all the pieces of the mechanism will be to hand.

For a man like yourself who is actively interested in the problems of commercial flight, and who has the means to occupy himself seriously in them, I can assure you that this machine deserves all your attention. It would be an advantage to the whole world that you should take it under your high and powerful protection. I am too old (69) not to be worried about its outcome if it were to remain in my hands alone, especially as I have been unable to raise the capital to finish it.

Please take my offer, and render for your country and the whole world the service of endowing them, in a word, commercial flight.

Briefly, you have nothing to risk, you will make millions of pounds in very little time. Take my science and you will have done a great and beautiful thing.

I am counting on an answer from you,

Yours faithfully,

A. Delprat."

In 1892 Delprat had produced a 64-page octavo booklet entitled *Navigation Aérienne, Aviation, Théorie et Practique*, which was published in Paris. In 1904 he was granted British Patent No 13,502 of June 15 that year for "Aerial Machines without Aerostats; propelling and steering" (described in *The Aeronautical Journal* as "Flying Ships with Flapping or Paddling Wings").

The patent describes upper and lower pairs of beating wings or blades driven by cams via connecting rods to the engine. The cams, which had "variable eccentricity at each end and a central dead point", imparted a "variable motion" to the wings, causing them to beat and also imparting an axial rocking motion in a variety of ways without interfering with the beating motion. This allowed the blades to be set to dip forwards or backwards during the stroke, consequently causing the "air ship" to move forwards or backwards. The lower pair of wings could also be fixed in the horizontal plane to act as brakes. The "aerial machine" was to be fitted with rudders "to improve its stability and facilitate steering".

Also in 1904, Delprat produced a pamphlet entitled *Flying Machines with Paddling Wings Having a Continuous Effect Without Balloons, Screw Propellers or Aeroplanes*, in which he propounded his theories.

WORK PROCEEDS

It seems that Alexander was not tempted by Delprat's offer, but work on the Frenchman's creation obviously proceeded. Like many of those who dreamed of powered flight in that era, Delprat was clearly convinced that he held the secret to success in his ornithopter, although how much experimentation he had undertaken before embarking on the creation of a full-size aircraft is unknown.

He must have managed to obtain some backing, because work progressed on a massive wooden structure over the next two years. In 1906 he had an article entitled *Sulla Teoria del Volo* (On the Theory of Flight) in the *Bollettino della Società Aeronautica Italiana* (Bulletin of the Italian Aeronautical Society, Rome). In November of that year photographs of Delprat's partly-completed flying-machine were published in the popular press. To passers-by it must have seemed amazing, but few would have suspected that it was meant to fly. It looked more like a large section of a stranded ship, or a big and rather eccentric house. It gives the same impression today.

OPPOSITE PAGE ***The fuselage of André Delprat's ornithopter-powered flying-machine in its incomplete state in Alexandra Park in November 1906, with the front presumably on the left. The large vertical slots in the top deck allowed for the movement of the wings, the powerplant being housed above the passenger accommodation.***

British Patent No 13,502
Delprat, A., June 15, 1904

DETAIL DRAWINGS FROM Delprat's 1904 patent for "Aerial machines without aerostats; propelling and steering", showing the complex mechanism for driving and controlling the beating wings.

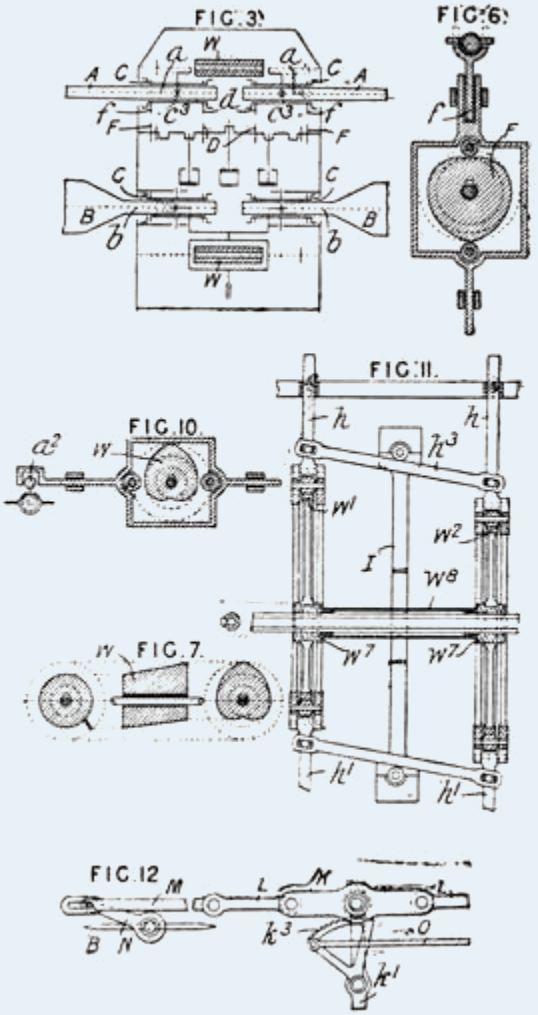


Fig 3 concentrates on the wings, marked *A* and *B*, shafts marked *a* and *b* turning in sleeves marked *C* provided with ball bearings. **Fig 6** shows the arrangement of the cam used to propel the wings. An axial rocking motion is given to the wings, without interfering with their beating motion, by cam *W* acting on the bearing a^2 in **Fig 10**. The cam is shown separately in **Fig 7**. **Fig 11** shows how, by the use of cams, the blades could be set to dip forwards or backwards during the stroke, causing the machine to move forwards or backwards. The wings (*B*) could also be fixed in a horizontal plane to act as brakes, by means of the device shown in **Fig 12**.

The Illustrated London News, in its issue for Saturday, November 10, 1906, published a photograph captioned "The weirdest thing in flying-machines: the latest experiment", and stated the following:

"It seems difficult to realise that the shed-like building in the photograph is intended to fly, but such is the intention of its inventors. The machine is being built by some Frenchmen in North London. It will have eight aluminium wings, each 18 yards long, to lift it, and four to propel it. It is pointed like a ship's bow, and is designed to carry 100 passengers."

A more complete description, accompanied by caustic comments, had appeared in the November 2, 1906, issue of *The Morning Leader*. This newspaper's account, headed "New Flying Machine: To soar over north London on aluminium wings" is worth quoting in full, including the original subheadings:

"At New Southgate a few scientific Frenchmen are busy constructing a machine which they are confident will solve the problem of aerial navigation. Only now, when the extraordinary apparatus (visible from the highway) is beginning to take such a shape as never was before in this world, is attention being attracted to the adventure.

The body of the machine, though far from being finished, is sufficiently crystallised out of the specification, as it were, to be something like its final form, minus the lifting and propelling gear.

Like a Freak Summer-house

What is to be seen from the road appears like a freak wooden summer-house built above the ground on a number of brick stocks. It appears like, for another resemblance, a dwelling for a whimsical eccentric who derides every local building by-law. The structure, which is of wood, is about 30ft high, and its length is perhaps but a third more than that. Roughly, it has the front elevation of a tipcat [a billet of wood tapered at both ends that is hit by a larger stick to propel it upward and then hit again by the stick to drive it forwards]*, and in shape might be called a squashed cylinder.*

Naturally the builders are reticent concerning its specialities, but the Leader *representative was informed that the inventor was Mr Delprat, of Paris, and that he died a year ago.*

On Aluminium Wings

There will be no screw propellers. Instead, there will be eight aluminium wings, each 18 yards long, to lift it, and four dittoes to propel it. Each wing will have a 'feathering' movement, so that no resistance is offered to the air; when, for instance, a lifting wing has beaten downwards, it will turn edgeways (if the crew have any luck) when going up for another stroke. The

ALL IMAGES VIA AUTHOR

ABOVE ***A rear view of the Delprat machine, with someone peering out of the top window and a dog on the viewing "promenade deck" for passengers. The structure has been braced by cables to stop it being blown over in strong winds. Puzzlingly, the structure had doors fitted into its second storey as well as the first; one has to wonder why!***

motive power will be four petrol engines developing 500 h.p. [a five-fold increase on the power stated by Delprat in January 1905].

Another Year Yet

And it will not be finished for a year at least; so this horrible pterodactyl, with a big, shocking body of wood and iron and 12 shining wings, will not startle North London yet. At present the machine looks as if it would fly quite as easily, when it gets its 18 [sic — 12] *wings, as would the Mansion House if 18 pocket-handkerchiefs were waved out of its windows."*

These rather derogatory descriptions seem to be the last records of Delprat's creation. Doubtless his death adversely blunted any incentive to complete the machine, and the structure was probably broken up shortly thereafter. At the time, most people were unaware of the Wright brothers' work in the USA, but experimenters in Europe such as Vuia, Ellehammer, Blériot and Santos-Dumont were making early progress with primitive propeller-powered, fixed-wing aircraft on a much smaller scale. Even at that early stage it must have been impossible for anyone with a smidgeon of common sense to believe that Delprat's giant flying dinosaur had even the remotest chance of success.

PHOTOGRAPHS BY THE AUTHOR

OFF THE BEATEN TRACK

Ever turned a corner to find something unexpected? The Aviation Historian's *intrepid aeronautical explorer* **PETER DAVISON** *investigates the stories behind the oddities that turn up in the most unusual places . . .*

A SIGNIFICANT NUMBER of former American- and Canadian-operated North American B-25 Mitchells found their way to South America after the Second World War. The *Fuerza Aérea Boliviana* (Bolivian Air Force) first requested 20 in 1943 under Lend-Lease arrangements but this came to nothing.

In 1973 a deal was reached with Venezuela to transfer nine North American F-86F Sabres and seven B-25J variants, some 4,318 of which were built in Kansas during 1941–45. After the type's retirement in 1979 several were transferred to the Bolivian civil register, often for meat-hauling duties, but none of these appear to have survived.

At least four of the B-25Js were operated from Cochabamba, mainly by the *Transportes Aéreas Militar* (TAM), making the example seen here, serial FAB-542, an appropriate display item for the city. It is located on the Rotunda del Avion, Plazuela Gral de Avenue Walter Arze Rojas, where it has been since at least 1985. It was restored to good order in November 2002.

Of the remainder, only one, former RCAF B-25J FAB-541, survives today, registered N25NA and named *Super Rabbit* with the Oklahoma Museum of Flying. It is thought that FAB-542 may also have been a Canadian example.

TOP & ABOVE ***North American B-25J serial FAB-542, formerly of the* Fuerza Aérea Boliviana*, on its plinth near Jorge Wilstermann International Airport at Cochabamba. To view the aircraft on Google Earth, type 17°24'39.2"S, 66°09'52.7"W into the Search box.***

the westland affair / SAC RB-29s / de chappedelaine aérogyre / swiss hunters / long-range PR spitfire / short c-class flying-boats / costa rican mustangs / WW2 RAF ammo / faucett airlines / victor & the martel / american aviators in japan

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